HEATING & VENTILATING
AIR CONDITIONING

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FOR OCTOBER, 1937

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THIS MONTH'S COVER: Williamsburg Houses, a $13.5 million housing project into which the first tenants moved September 29. The project, approximately 91% complete, is leased by the New York City Housing Authority and was built by private contractors with PWA funds. The project will house 1622 families in 5688 rooms.

For Engineers and Contractors Controlling the Design, Specification, Installation and Maintenance of Heating, Ventilating and Air Conditioning.

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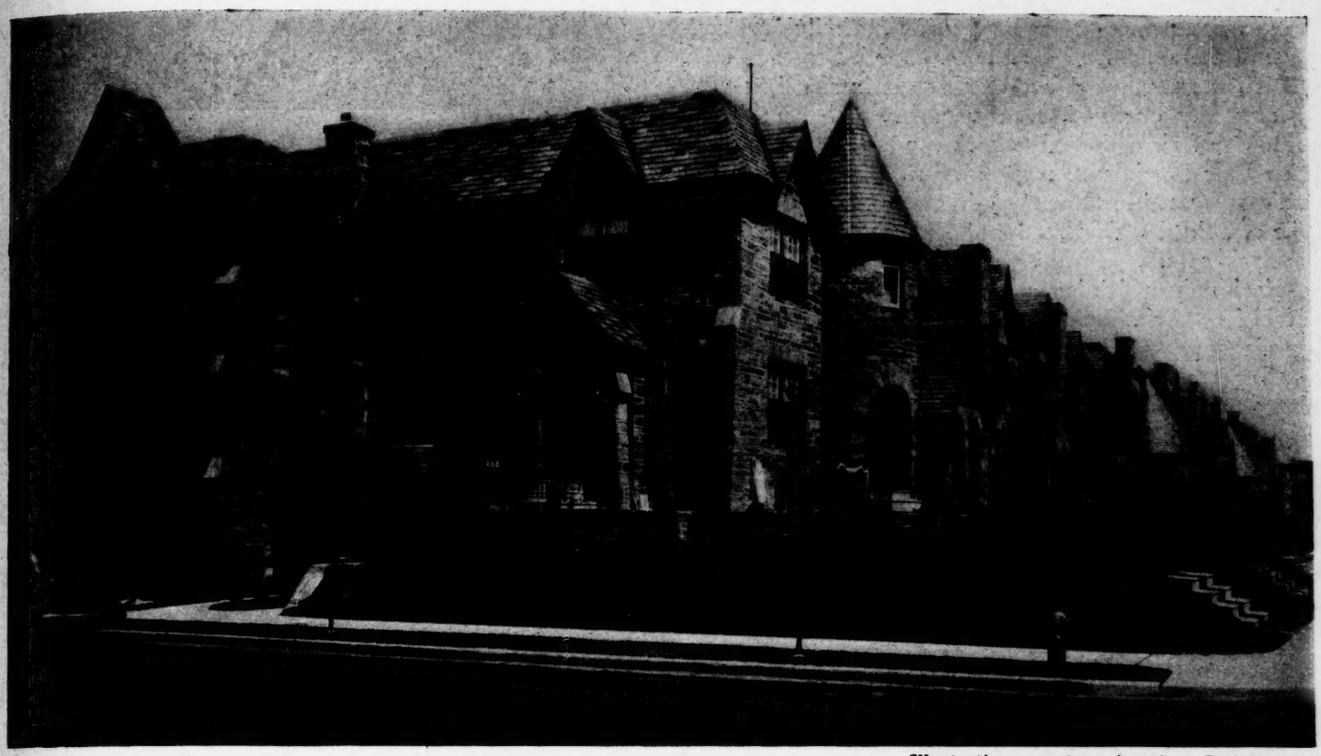


Illustrations courtesy American Radiator Co.

This two-family, 10-room house in Philadelphia has separate air conditioners for each apartment. The building is of brick and stone construction.

Radiator Heat System for Two-Family House with Individual Air Conditioners

DEMONSTRATING how difficult air conditioning distribution problems may be overcome through the use of auxiliary air conditioning units with a radiator heating system, an installation at 1651 Grange Ave., Philadelphia, installed by the National Plumbing and Heating Co., Philadelphia, was designed to provide an individual supply of conditioned air for two separate apartments in one house while the heating for both was done through a single forced circulation warm water heating system.

The building, the end house in one of the Quaker City's familiar row type developments, is of brick and stone construction and was built to sell for $9000 by the Castor Highland Development Co., Philadelphia. Having 10 rooms and two baths, the house is divided into two separate apartments of five rooms each, with the space originally provided in the basement for a recreation room being used for a doctor's office.

Illustrating the adaptability of radiator heat conditioning as opposed to other types, a single heating system was provided for the house, with a separate conditioner installed in the basement for each apartment so that the different conditioning requirements of the two apartments could be met independently.

A recent installation, described in this article, illustrates the flexibility of radiator heat air conditioning. A single forced hot water heating system supplies the whole building, in the basement of which are located two air conditioners, one for each apartment. Heating, cleaning, air circulation, and humidification are provided.

Two Conditioners Used

The conditioned air is obtained from two ceiling-hung auxiliary air conditioners of the type that can be installed at any point on the heating mains, which were, in this case, installed above and in front of the boiler. Humidification, filtration, and air circulation are provided.

A simplified system of air mains consisting of one supply main and one return main is used for each of the two separate systems. The air mains are of sheet metal approximately 24 in. by 6 in. and are concealed. With the outlet placed in one room and the return in another, the outlet was located so as to cause a constant mild circulation of air both in and between rooms throughout the entire apartment through the operation of air pressure equalization. Outlets and returns were placed in the wall just above the baseboard with air delivered at a low velocity, or approximately 225 f.p.m., from the supply inlet so as to avoid drafts.

Although a single outside air intake duct supplies outside air to

both units, provision has been made for individual control of the amount of outside air supplied to each unit. This is accomplished by splitting the intake duct with a manually operated, selective damper to control the amount of air delivered to each conditioner. An insertion type humidistat, controlling the humidifier in the unit, is located in the return duct at a point just before the combined recirculated and fresh air enters the unit in each case.

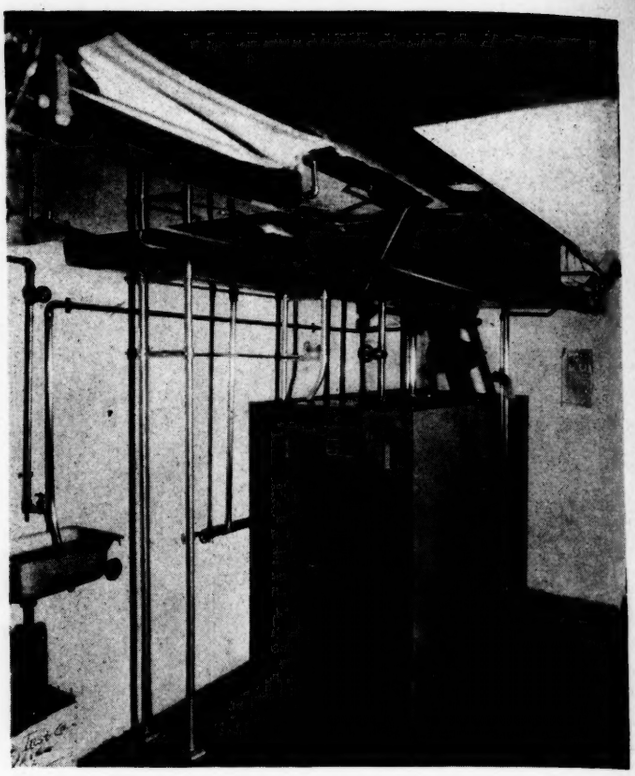
Each unit, which has a capacity sufficient for a house of 12,500 cu. ft., includes a filter for cleaning the air, a special spray nozzle which operates against a plate glass baffle plate for humidification, a tempering coil, and a fan operated on a ¼-hp. motor. A canvas connection is provided between the discharge from the conditioner and the end of the supply main so as to eliminate vibration and sound. Recirculated and outside air enters the unit through the filter, passes through the humidifying spray, then through the tempering coil, after which it is taken by the fan and delivered to the rooms through the duct system.

Control of Humidity

The percentage of outside air combined with the recirculated, in addition to providing ventilation, serves as a check against over-humidification with the humidification chamber placed ahead of the tempering coil in the air conditioner so that the temperature of the mixed outdoor and recirculated air acts as an automatic check against over-humidification or impractical humidification on cold days.

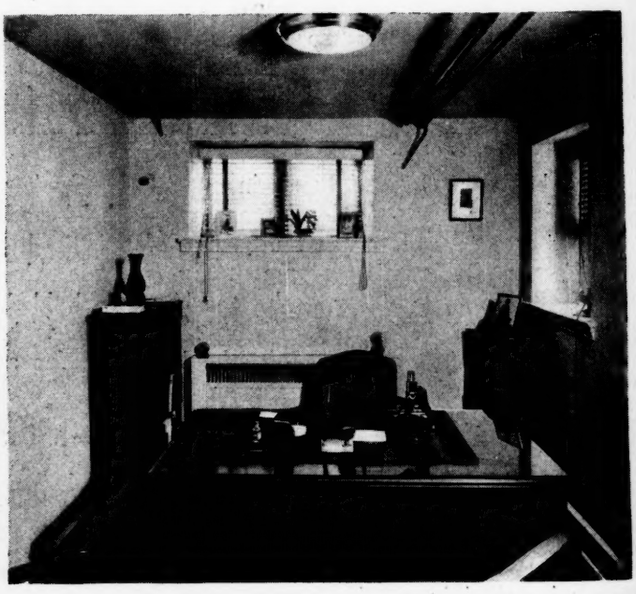
With this arrangement, as the outside temperature drops the temperature of the mixed air in the humidifying chambers drops with it, and the capacity of this air to absorb moisture is decreased, thus removing the danger of condensate on cold walls and windows that might be caused if a fixed relative humidity were maintained in the air.

A switchplate is provided in the hall of each apartment for manual control of the conditioning unit supplying that apartment. On the switchplate is a switch controlling the operation of the humidifier, and a second, controlling the fan, which makes it possible to run the fan continuously without the humidifier.



The air conditioning installation showing copper pipe and fitting, 80-gal. copper hot water storage tank, and one of the auxiliary air conditioning units. A section of the other unit appears in the upper left hand corner.

Both the conditioning units are connected on the heating system, which is entirely automatic with a gun type burner being used on a rear-fired, oil-burning boiler with an extended jacket to cover the burner. Copper piping is used in the heating throughout, and radiators are of the cast iron convector type set in re-



(Left) The dining room in the lower apartment. The convector radiator is shown under the window and the air conditioning supply grille is located in the wall above the baseboard. (Right) Finished room in the basement of the house is used as a doctor's office. Note exposed copper piping run close to ceilina.

cesses, with a radiator used in every room. Metal enclosure fronts are provided on the convectors so as to maintain a constant mild supply of radiant heat. A garage in the basement is heated by means of a wall-hung tubular radiator.

A total of 28 radiators, making up 1100 sq. ft. of radiator and the two conditioners are connected on a single forced circulation warm water system, using a nine-section cast iron boiler equipped with a 100-gal. built-in water heater for summer and winter domestic hot water. An 80-gal. copper alloy storage tank is connected to the domestic hot water supply.

As the house was constructed with a minimum of waste space, the contractor used wrought copper pipe and fittings throughout the heating installation so that the smaller pipe sizes, rust resisting qualities, and the lack of the necessity for insulation would aid in giving a more finished appearance to the basement where piping is necessarily exposed, making possible the utilization of this area.

Pipe sizes, through the use of copper, have been reduced to 1 in., and tests that have been conducted in the house have shown that a complete circuit of hot water from the boiler through the radiators and back to the boiler is accomplished in 1 min. and 50 sec. from the time that the thermostat calls for heat.

A flow control valve is used on the system to minimize fuel consumption. When the thermostat, located in the dining room of the upper apartment, calls for heat, it starts the circulator which develops sufficient pressure head to open the flow control valve and circulate hot water through it to all radiators. After the thermostat is satisfied, and the circulator shuts down, the flow control valve closes and shuts off all thermal circulation so that there can be no overheating and waste of fuel.

Air Cleaning

DURING the last few years the development of air conditioning apparatus has drawn our attention to the possibility of removing the smoke from the air used for ventilation so that we can have clean air in our buildings. A good discussion of air cleaning and of the methods of testing air cleaning devices was given by G. W. Penney in a talk before the Smoke Prevention Association, New York, recently. Abstracts follow:

In air cleaning we are not only dealing with particles of numberless substances but also the shape and size of the particles may vary widely. One standardized test for air cleaners uses a mixture of dusts sifted through a 200-mesh screen. Such a screen will just pass a particle 0.0025 in. in diameter. For most purposes this is a very fine material but in terms of atmospheric pollution it is a coarse material. Ragweed pollen which is the cause of the common hay fever, consists of particles about 0.0008 in. in diameter, while the average particle of tobacco smoke is only 0.0000039 in. in diameter. These sizes are so small that they are beyond our perception so that it is difficult to picture such sizes. To get a better conception of the size let us suppose that we could have a microscope with a magnification of 250,000 diameters. Through such a microscope the average tobacco smoke particle would be about an inch in diameter, or about the size of a golf ball. The black smoke particles in our air would vary widely but on the average would appear to be about the size of a baseball. Ragweed pollen would be about 17 ft. in diameter, while the particles just passing through a 200-mesh would appear to be 50 ft. in diameter. With such a range in sizes, testing a filter with the large particles is no measure of its ability to remove the fine particles.

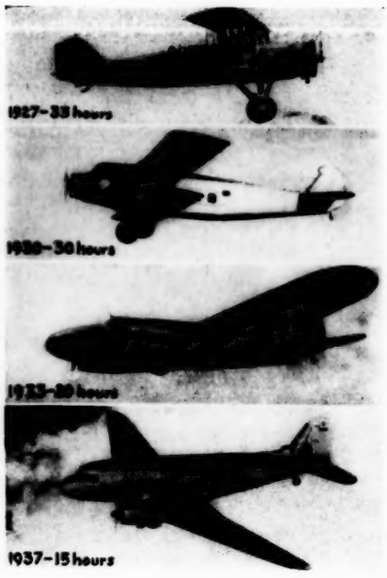
The determination of the efficiency of an air cleaner is difficult because of this wide variation in material, shape, and size of the particles to be removed. Unless the test dust is representative of the dust to be removed in service, the results may be very misleading.

The variation between tests may be so great that a test according to a standardized weight test may show over 95% efficiency in removing the dust used for test, whereas the efficiency of the same filter in removing the actual atmospheric dust may be less than 25% according to other recognized test methods. For example, the test referred to above permits test particles up to 0.0025 in. in diameter but such a particle has a volume over 200,000,000 times that of the average tobacco smoke particle. If, then, we imagine a dust consisting of one such large particle to 200,000 tobacco smoke particles, the one large particle would weigh 1000 times as much as the 200,000 small particles so that a filter removing only the large particles would show a weight efficiency of 99.9% even though it has removed only one particle out of 200,001. This is an extreme case since any dust will have particles of intermediate size but it does illustrate an error so great that actual tests by one method may show 99% while by another method, less than 10% efficiency.

One test which is readily made and given a good indication for many purposes is made by passing air to be tested through cloth or filter paper. If the dust is black, a white cloth or paper is used. The method consists in passing a certain quantity of unfiltered air through a given area of cloth or paper. By running several air cleaning devices simultaneously and taking samples which compare unfiltered city air with air passed through a mechanical filter which filter gives a high efficiency when tested by the weight test using dust sifted through a 200-mesh screen but on this atmospheric dust shows a low efficiency. The third sample is from an electrostatic precipitator which can be made to give a high efficiency on all types of dust.

This type of test can be made quantitative by passing a standard quantity of unfiltered air through one piece of cloth and varying the amount of filtered air passed through another sample so that the same degree of blackness is obtained. The efficiency is specified in terms of the quantity of air required to give this blackness. For example, if 1 cu. ft. of unfiltered air gives the same blackness as 20 cu. ft. of filtered air, the filter is said to be 95% efficient.

COMFORT ALOFT



1927—Crude heating from exhaust.

1930 — Improved heating; introduction of soundproofing; some ventilation.

1933—Steam heating introduced; soundproofing improved; planes cooled before takeoff.

1937 — Scoop introduces outside air for ventilation; improved steam heating; advanced soundproofing.

TEN YEARS OF COAST-TO-COAST FLIGHT

A DECADE after the first commercially operated mail-passenger planes flew their inaugural schedules over the New York-Chicago-California airway, the tenth anniversary of commercial coast-to-coast air transportation was celebrated in September.

Pioneered in 1919 and 1920 by mail planes of the Post Office Department, this airway had a background of more than seven years of operation before the predecessor divisions of United Air Lines Linked the Atlantic and Pacific.

The pioneering passengers flying from California to New York in a single-engined, two-passenger biplane enjoyed few comforts. Their trip involved thirty-three hours or more, including fourteen stops along the route. Today the 12-ton, 200-mile-an-hour Mainliners span the continent in 15 1/3 hr. with only three stops. The small cabin on the pioneering planes was poorly ventilated. The cabins were noisy, since aircraft engineers knew little or nothing about soundproofing methods for air plane interiors. A crude heating device, attached directly to the engine exhaust provided all the heat that was available. This was often unsatisfactory and United provided heavy blankets for its passengers as a precaution against suffering from the cold.

Today the coast-to-coast transports reflect the tremendous advances that have been made to provide superior accommodations for passengers. Before each United plane leaves a terminal, passengers notice that a large truck comes alongside the ship and mechanics attach a 6-in. hose to a fuselage connection. This truck, in the summer time, is used to keep the plane cool while it is on the ground, and during the winter, keeps the cabin warm during terminal stops.

A storage tank which cools the brine is located in a special building at the terminals. When a truck tank has been loaded, it carries enough brine to cool air for six hours. In operation, it pumps 1000 c.f.m.

The steam heating system on the Mainliners is located in the forward part of the fuselage, between the passenger compartment and the pilots' cockpit. It consists of a boiler which is heated by the engine exhaust. Steamflow through the radiator is regulated manually by the stewardess and is often used during the summer months. In fact, this past summer one stewardess reported that she turned the heating system on at 12,000 ft. where the temperature was below 55F. On the ground at Chicago when the plane landed the temperature was above 100F.

A filter-equipped fresh air duct or scoop is located in the nose of each Mainliner and the flow of fresh air at each seat or in each berth on the sleeper planes can be controlled by the passenger. Since the transports of 1937 cruise at 10,000 or 12,000 ft. where the air is always fresh and cool, air line engineers can see no need of installing air conditioning units in the planes. They do, however, stress the importance of ground units, and air conditioning development in the aircraft field will continue along this line.

(Left) Dressing rooms on a modern Mainliner. (Right) A section as it appears during the daytime. At night this space is made into an upper and lower berth.

Typical residential group in Greenbelt Village, Berwyn, Md.

Selecting Heating Equipment for a Large Suburban Housing Development

By ROBERT THULMAN

THE Resettlement Administration's town of Greenbelt, located five miles from Washington, D. C., near Berwyn, Md., was completed and ready for occupancy early this fall. Planning and construction of the town was under way for about two years. The effort represents a new approach to the problem of low rent housing in that, instead of erecting new houses in congested urban areas, the Administration secured a 2000-acre tract adjoining property owned by the Federal Government for experimental work in agriculture, foresty, and soil conservation, and has developed a complete town to house, ultimately, 3000 families.

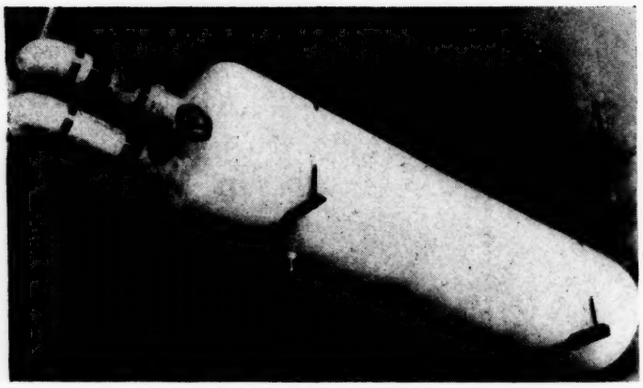
The town of Greenbelt, Md., is made up entirely of new buildings erected by the Resettlement Administration as an example of suburban low rent housing. In selecting the heating equipment the engineers of the Administration were faced with the problem of designing systems which would provide uniform comfort conditions with a low operating cost. All types of heating systems were investigated and the final solution involved a combination of a number of existing systems. Several new and unusual ideas were included. This article is not officially approved by the Resettlement Administration

The town is completely encircled by a protective green belt, upon which there can be no future encroachment. All of the houses are to be rented and all the operations of the town are concentrated in a management division. In order to accommodate families of modest income, it was essential that all the items entering into the equivalent rent should be kept at a minimum. Also in order "to encourage that kind of family and community life which will be better" than such families now enjoy, it was felt to be mandatory that the housing should be provided with heating equipment capable of maintaining 70F in all habitable rooms and that a condition of uniform comfort should be provided.

The cost of heating is ordinarily the largest single item of rent; its reduction is possible in two ways:

1. Reduction of the heat requirements by good construction, and
2. Efficient fuel utilization.

As a preliminary step to the design of the heating systems and even before the type of heating was decided upon, considerable study was undertaken of various types of wall construction, roof construction and windows from the standpoint of heat conservation. Such study consisted of comparisons of various types of walls, windows, and roofs with those necessary to meet minimum construction requirements. It was



Hot water generator and storage tank which supplies domestic hot water to individual dwellings.

found that insulation of both the walls and roof was not only necessary to reduce the heating cost to an afforded amount, but represented a paying investment. In reducing heat requirements, however, it was found that there was available in the market, little or no equipment sufficiently small in size and, at the same time, reasonably efficient to heat each house individually.

The development of the architectural plans for the first unit of the town resulted in the adoption of row housing, consisting of anywhere with from two to eight houses per building. 157 buildings of this type provide accommodation for 574 families, and in addition there are 12 apartment buildings, housing 306 families, and 5 individual experimental houses. In addition to the 174 residence buildings housing 885 families there is a school and community building, fire house, service station, two store groups (one of which contains a moving picture theater), a bath-house, and boat-house. The residence buildings are grouped in super-blocks, a system of grouping which, at first glance, appears to lend itself to either a single central heating system for the whole town or one central system for each block. Cost analyses of both these systems indicated that the initial heating cost per unit would be rather high due to the large amount of underground steam piping necessary in either case. Difficulty was already encountered with the adoption of an individual plant for each family unit due to the small size necessary. Consequently a study was made of the costs of installing a separate heating plant for each building. This scheme increased the heating plant size so that efficient equipment available in the open market could be applied.

In addition to more efficient fuel utilization, further advantages offered by this solution are: lower maintenance due to management operation, economical use of oil fuel with consequent less restriction from the site planning standpoint, purchase of fuel in large quantities at a lower cost, the use of outside temperature control resulting in greater uniformity of heating, and the elimination of waste due to overheating and tenant-abuse.

Several types of heating systems were considered. One-pipe steam, while apparently the cheapest system to install, seemed to require relatively high maintenance costs due to more rapid corrosion of pipe and also difficulty with the possibility of noise developing in the system. The principal objection, however, to the use of steam as a heating medium was the intermittent character of the heat output of the radiators. One of the objectives of the design of the heating system was to provide as great a degree of uniformity of heat output as possible. Reasonably effective, and at the same time low-priced, control equipment for a steam job which would eliminate the indoor thermostat was not available.

The use of hot water as a heating medium reduced the maintenance problem to a minimum, provided an economical method of obtaining practically continuous heat output from the radiation, and eliminated the noise problem entirely. Also the type of control which was felt to be essential to the proper operation of the system was available at a reasonable cost. One manufacturer offered a unit type of heating, consisting of an indirect coil, small blower and filter unit, and a system of duct distribution, using air as the direct heating medium with hot water in the heat exchanger. It was decided to try several of these units in some of the buildings.

The adoption of the semi-central system and the use of the super-block principle of town planning with no roads or driveways close to the buildings practically eliminated the possibility of using coal as a fuel because of the delivery problem. The only cellar space in the buildings was that provided for the heating plant. Consequently, storage facilities for coal were not available. Gas also was not available. It was, therefore, decided to use oil.

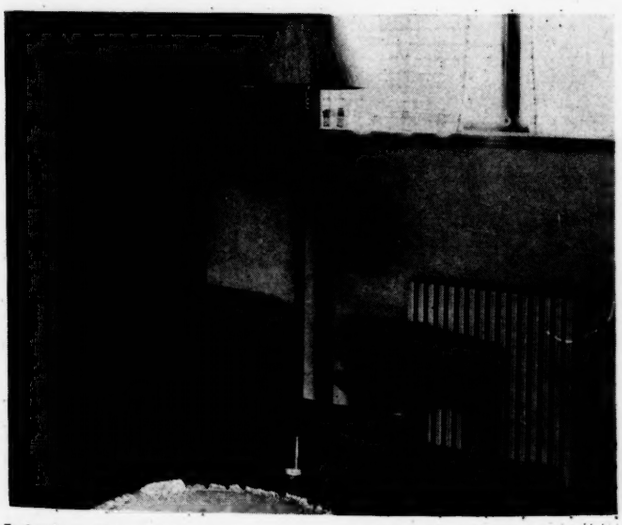
The heat losses of the row units were within the

Hot water circulator showing bypass for gravity circulation and valves for controlling circulation.

Typical view of Greenbelt Village.

range encountered in ordinary residences and varied from 70,000 to 250,000 B.t.u. per hr. Consequently, the adoption of the familiar residence type of oil burner was indicated. Specifications called for pressure atomizing type burners to burn No. 4 fuel oil. Although economic studies of the advisability of using heavier and cheaper oil requiring more expensive burner equipment were made, the saving in the use of the cheaper fuel did not warrant the additional capital cost and the expense of preheating. In the store buildings, community center and the apartment buildings, where the concentration of the load was much greater, the analysis showed that the expenditure of additional money for heavy fuel oil burners *was* justified, and they were consequently used in these buildings.

In setting up the policy for a low rental housing project of this type, maintenance cost of the buildings and their equipment must be continually balanced against amortization costs. At the time purchase of material was being made for the project, copper was at one of its lowest prices in history, and the project was able to purchase copper pipe for both plumbing and heating at a very attractive figure. However, the price differential between copper and steel was not so great that the project could ignore the advantage of using smaller sizes of pipe which were possible with a forced circulation system. Also, most of the buildings were so long that excessively large pipe sizes would have been required had the systems been designed for gravity circulation. Again due to the capacities required, the entire selection of circulator equipment for the ordinary residence was available and the systems were designed to use the familiar residence hot water circulator. In each case a bypass line was provided around the circulator so that in case of breakdown, some gravity circulation would be possible, and provision was made by means of valves for disconnecting any circulator without the necessity of draining the system.



Interior view showing supply and return connections on same end of radiator.

Certain economies were possible through the use of exposed risers to the radiators. Because of the small size of pipe required, the exposure of the risers was not particularly objectionable from the architectural standpoint. This fact also permitted the placing of the radiators symmetrically under the windows. Free standing, narrow tube radiators were used throughout. These rested on the floor on legs but, in addition, were securely anchored to the wall.

The design of the temperature control system was based on the fact that heat emission from the radiators varied almost directly with the temperature difference between the heating medium and the air. The boiler temperature was maintained continuously by aquastat control at 180F and the proportion of constantly high temperature boiler water with lower temperature return water was varied by means of a proportioning valve controlled from an outside thermostat. Operation of the valve mechanism was accomplished by expansion or contraction of liquid contained in a bulb located outside the building and connected to a bellows on the valve itself through a capillary tube.

Several methods of heating domestic hot water were investigated. It was essential to guard against the possibility of waste. The water supply to the house was metered individually for each family unit in the row housing. High temperature boiler water was available all year round by reason of the control system adopted. The scheme worked out for the provision of domestic hot water consisted of the installation of a 30-gal. storage tank in each family unit equipped with an indirect heating coil through which hot boiler water was circulated continuously with the same pump used for the heating system. Extravagant use of hot water was thus checked because such use would merely result in the draining of the hot water in the tank, after which it would be necessary for the tenant to wait until the tank had been reheated. The hot water as well as all of the cold water was charged directly against the tenant on his own meter. This scheme also obviated the necessity of providing a domestic hot water circulating system throughout the length of each building, as the supply for each unit was concentrated close to the hot

water taps for that unit. Hot water for the apartment buildings was supplied as a part of the rent and generated in a central tank in the boiler room by circulating hot water through an indirect coil similar to that used in the row houses.

Almost all large scale housing projects, particularly of the slum clearance type, have employed a central heating system. It has been suggested several times that this would have been the logical solution for Greenbelt, but the Greenbelt project differs materially in town plan. Provision of large open areas between the houses for play space and the layout of the buildings in super-blocks resulted in a diffusion of load, which practically eliminated the idea of central station heating. In this respect the general heating scheme should not be considered a criterion, but in other respects it should. Many large scale housing projects are being erected today with no provision for proper temperature control beyond that provided by the superintendent or engineer manually. Certainly the use of hot water as a heating medium seems to have been a wise selection and, provided the height of the buildings of any project is not too great, there is no reason why it should not be used on other projects. The simplicity of the design, the low maintenance characteristic and extreme flexibility to take care of unusual conditions make it an ideal heating medium. The objection to its use in milder climates due to long retention of heat in the radiators may be readily overcome by proper outdoor control. This type of control anticipates changes in room temperature before they occur and if properly adjusted and installed in a well designed and well balanced system affords a room to room uniformity not possible with steam.

If there is to be a great deal of housing of the individual type built in the next few years and if such housing is designed with the economic aspect as the controlling feature, it is essential that manufacturers of heating equipment provide units much smaller and much more efficient than they are marketing at the present time. This condition was evidenced in the design of the heating systems for the five experimental houses at Greenbelt where the maximum heat loss was approximately 45,000 B.t.u. per hr.

In keeping with the objective of the Greenbelt town, the heating system should be regarded as a demonstration of the logical approach to the problem and not necessarily the solution to the problem of low cost heating for low cost housing. As long as housing projects take varying forms, heating systems will also vary in the form, but the fundamental approach should always be the same and should be governed by operation and maintenance cost which can be afforded, consistent first cost, and adequate performance.

Humidity and Building Materials

PRACTICALLY all heating and air conditioning men know that a pressure differential exists across a wall which separates spaces with a high and low moisture content. Most of them, however, do not realize how great this pressure may become or how much moisture may be forced through the wall. An excellent discussion of vapor pressure and of the transmission of moisture was given by Prof. T. G. Miller of Michigan State College in a talk on humidity presented before the mid-year convention of the National Warm Air and Air Conditioning Association in Cleveland on June 9. Abstracts follow:

If we are to maintain a high percentage of humidity with its resultant high vapor pressure during the heating season when, due to low temperatures, the humidity is low outside, something of a problem presents itself in the form of containing this vapor. The difference in vapor pressure between inside and outside of a comfortably heated space is in the order of 10-15 lb. per sq. ft. in average winter weather. With this differential, it does not take a great imagination to picture the vapor finding paths of least resistance around windows and doors through plaster cracks, weather checks, and other defects. Since this vapor may act independently of the air, it may in some cases be going out through the same space air is entering. Good construction is imperative if a semblance of recommended humidities is to be maintained.

These vapor particles, however, are not content to follow the obvious and unobstructed path outward. They have the ability to pass through the microscopic interstices between the aggregates of building material. Even the most carefully made material nationally advertised as a vapor seal will pass about 100 grains per sq. ft. per day under average winter conditions. This would amount to about 45 lb. per day from an average house, adding a ton of coal per year to the fuel requirement. To explain how this vapor can pass through such dense material, we only have to be reminded that these molecules are practically spherical in shape and only 4 angstrom units or 4. x 10^{-8} c.m. or less than two hundred millionths of an inch in diameter and are traveling at a speed in excess of 2000 ft. per sec. at 32F. Metal foil, lacquered surfaces, asphalt impregnation, or any other of the waterproofing processes may retard this passage to varying degrees but will not prevent it.

At the present time, we seem to have a variety of opinions as to what happens to the vapor after it leaves the heated space. Some have claimed that this vapor might condense in and deteriorate the building material or insulation. This seems quite improbable in the light of recent investigations which show ready passage of moisture through all types of building construction. Theoretically a pressure gradient, similar to the temperature gradient through walls, could be drawn showing acceptance of moisture on the inside and delivery to the outside. Practical evidence of this transit is seen in the opening of a large number of walls, variously insulated, showing absolutely no evidence of moisture collection or structural depreciation.

Date Heating Season Begins in a Normal Year

On occasion the air conditioning engineer may, particularly if his work extends over a wide area, desire data as to when the heating season begins and ends. At other times, in a number of locations, he may wish to determine the average temperatures of the heating seasons in those places. To do this he frequently uses the average temperature for the period between certain arbitrarily set dates, usually October 1 to May 1.

The dates of the beginning and end of the heating season are not, however, determined by man-made laws. The conditions which cause a heating season to begin and end depend entirely on the weather in the particular period under consideration, and the dates it begins and ends depend both on the weather and on what definition we set up for the term heating season.

Definition of Limiting Date

The heating season may be said to begin on the day in the early or late fall when artificial heat is required for comfort. Obviously, though, this varies widely even in the same city, since some persons feel the need of heat less than others. Or the season can be said to begin on the first day when there are degree-days in the fall.

In a given locality, the first day in the fall having degree-days may occur early one year and late the next. Complete data, approaching ideal, would include information on the earliest and latest date when degree-days occurred in each city. Lacking such data, knowledge concerning the average or normal date when degree-days first occur is of value.

What the Map Shows

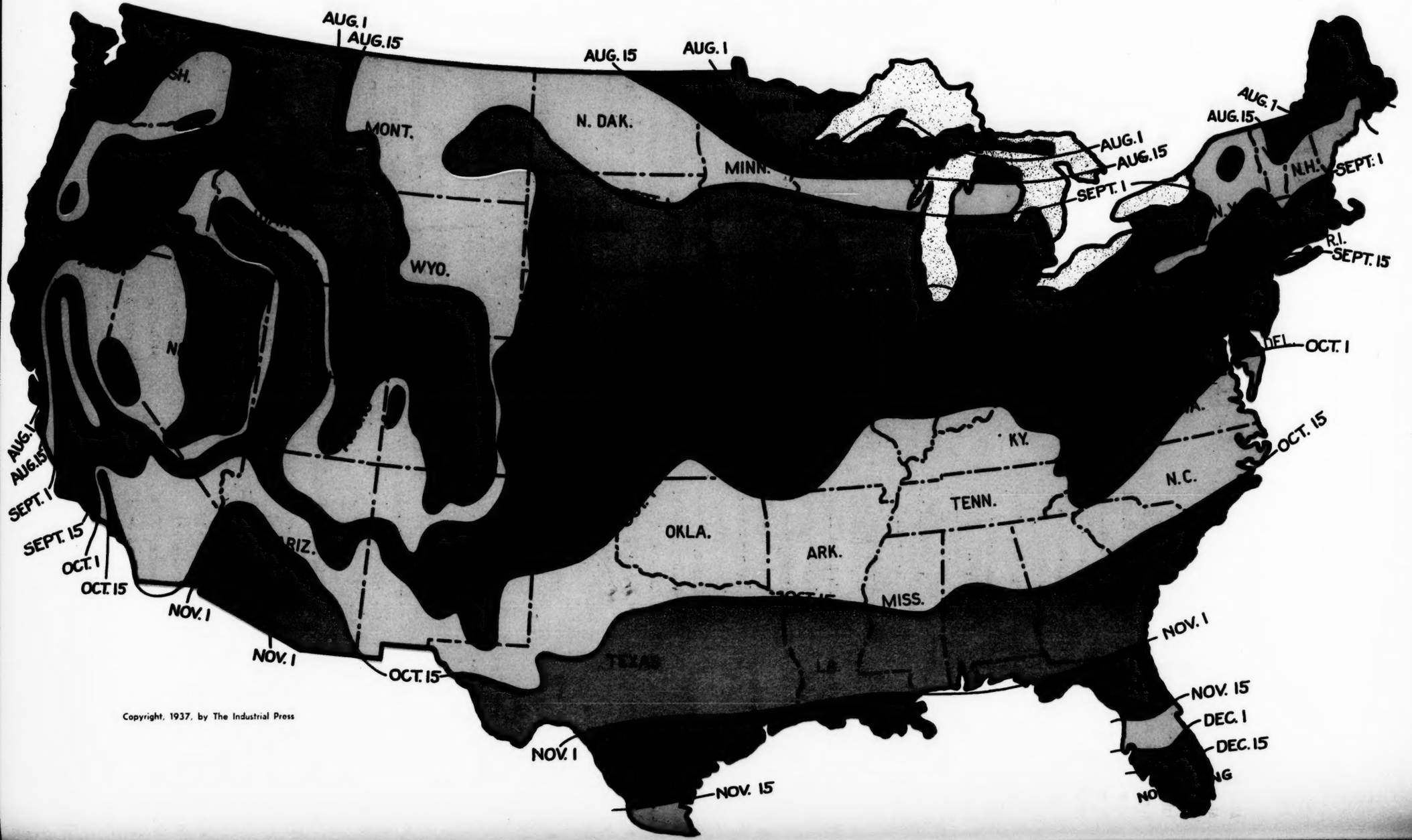
The accompanying map is designed to show this graphically. The dates are those when the normal daily mean temperature first falls below 65F. This is based on the conception of the degree-day that heat is required when the daily mean temperature falls below 65F.

Obviously, since this is based on normal or long-time average figures, it can be seen that in any given locality the heating season in a given year may begin earlier or later than the date shown, but the dates for a long number of years will average close to the date given.

Use of the normal also implies a condition that ordinarily never occurs in a given year—that once the heating season begins every day till the end of the season will require heat. In a given year the temperature fluctuates up and down so that degree-days may occur for a number of isolated days or periods before beginning the season in earnest.

Text continues following Map and Table

DATE HEATING SEASON BEGINS IN A NORMAL YEAR



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DATE HEATING SEASON BEGINS IN A NORMAL YEAR IN 100 CITIES

City	Season Begins
Albany, New York	September 10
Albuquerque, New Mexico	September 23
Atlanta, Georgia	October 10
Baltimore, Maryland	September 28
Birmingham, Alabama	October 16
Boise, Idaho	September 8
Boston, Massachusetts	September 10
Buffalo, New York	September 7
Burlington, Vermont	September 1
Butte, Montana	Year Round
Charleston, South Carolina	October 25
Charlotte, North Carolina	October 8
Cheyenne, Wyoming	August 22
Chicago, Illinois	September 21
Cincinnati, Ohio	September 24
Cleveland, Ohio	September 13
Columbia, South Carolina	October 15
Columbus, Ohio	September 22
Concord, New Hampshire	August 26
Dallas, Texas	October 18
Denver, Colorado	September 10
Des Moines, Iowa	September 19
Detroit, Michigan	September 12
Duluth, Minnesota	Year Round
El Paso, Texas	October 13
Erie, Pennsylvania	September 11
Eugene, Oregon	August 17
Evansville, Indiana	October 3
Fitchburg, Massachusetts	September 6
Flagstaff, Arizona	August 8
Fort Smith, Arkansas	October 11
Fort Wayne, Indiana	September 16
Frederick, Maryland	September 20
Grand Forks, North Dakota	August 15
Grand Rapids, Michigan	September 10
Great Falls, Montana	August 21
Greensboro, North Carolina	October 2
Hartford, Connecticut	September 9
Houston, Texas	November 2
Huntington, West Virginia	September 24
Indianapolis, Indiana	September 23
Jacksonville, Florida	November 6
Kansas City, Missouri	September 28
Knoxville, Tennessee	October 4
Lexington, Kentucky	September 28
Lincoln, Nebraska	September 21
Little Rock, Arkansas	October 13
Los Angeles, California	October 19
Louisville, Kentucky	October 3
Madison, Wisconsin	September 8
Memphis, Tennessee	October 13
Meridian, Mississippi	October 15
Milwaukee, Wisconsin	September 8
Minneapolis, Minnesota	September 6
Minot, North Dakota	August 16
Mobile, Alabama	October 28
Newark, New Jersey	September 20
New Orleans, Louisiana	November 4
New York, New York	September 23
Norfolk, Virginia	October 10
Oklahoma City, Oklahoma	October 9
Omaha, Nebraska	September 22
Paterson, New Jersey	September 18
Pensacola, Florida	October 31
Peoria, Illinois	September 14
Philadelphia, Pennsylvania	September 27
Phoenix, Arizona	October 31
Pittsburgh, Pennsylvania	September 21
Portland, Maine	August 25
Portland, Oregon	August 31
Providence, Rhode Island	September 7
Pueblo, Colorado	September 15
Reading, Pennsylvania	September 17
Reno, Nevada	August 30
Richmond, Virginia	October 3
Rochester, New York	September 7
St. Louis, Missouri	October 1
Salt Lake City, Utah	September 15
San Antonio, Texas	November 2
San Diego, California	October 6
San Francisco, California	Year Round
Savannah, Georgia	October 26
Scranton, Pennsylvania	September 11
Seattle, Washington	Year Round
Shreveport, Louisiana	October 21
Sioux City, Iowa	September 12
Sioux Falls, South Dakota	September 5
South Bend, Indiana	September 17
Spokane, Washington	August 30
Springfield, Illinois	September 25
Syracuse, New York	September 5
Topeka, Kansas	September 27
Trenton, New Jersey	September 23
Tulsa, Oklahoma	October 7
Vicksburg, Mississippi	October 21
Washington, District of Columbia	September 26
Wheeling, West Virginia	September 19
Wichita, Kansas	October 2
Wilmington, Delaware	September 24
Yuma, Arizona	November 8

Regions with Year Round Heating

In the extreme north of the country, along the Pacific Coast, and in the Rocky Mountains, are areas marked "Year Round". In these areas, the normal or average daily temperature is below 65F all year, implying that heat may be necessary the year round. The Pacific areas have, however, fairly warm days the year round; at night the temperature drops so that the mean daily temperature is pulled down. Since ordinarily few buildings are heated for cool nights accompanied by warm days, the term Year Round cannot be taken too literally. A similar situation exists in the North and in the Rockies in the summer, although in those regions warm temperatures do not prevail in daytime during winter. Generally, Year Round indicates that heat may be required at any time, with the season approaching 365 days.

The map is somewhat generalized in that there are occasional towns and cities with beginning dates not identical with the region shown on the map. These are not so shown due to lack of data and due to complications in presenting such a map; however, most of these spots are in the thinly populated Rocky Mountain states. The map is as accurate in the East and Middle West and along the Pacific Coast as is possible with existing weather data.

Effect of the High Mountains

Clearly shown on the map is the effect of the Appalachian Mountains in the East; due to their influence Asheville, N. C., has as early a heating season as Albany, N. Y. Similarly, the Rockies, Sierra Nevada and other western mountain ranges push the lines far south and otherwise confuse the picture.

In the East the lines run in an east-west direction, the difference in date being due almost entirely to latitude. A line running almost directly north and south on the western edge of South Dakota and Nebraska is prominent since it marks with abruptness the departure from the usual east-to-west direction.

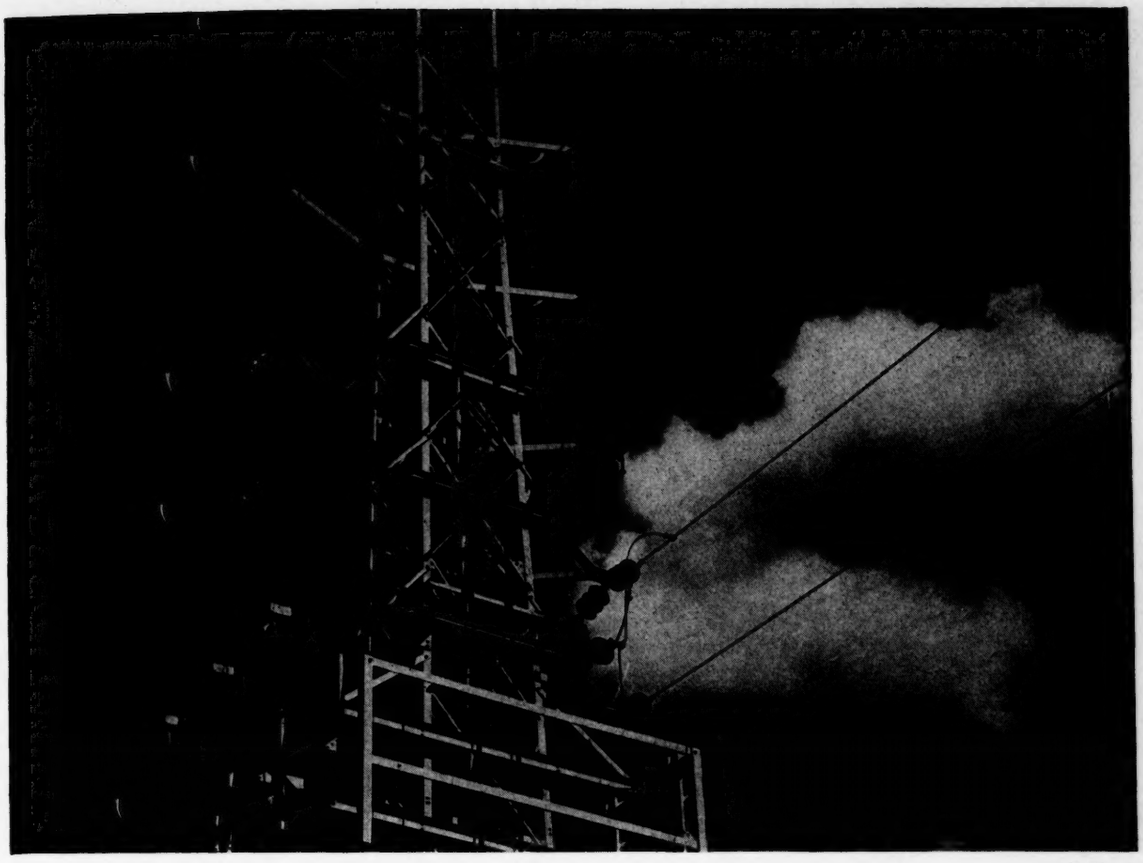
This line closely follows the dividing lines between radically different climates. To the east are the humid regions; to the west and across the mountains lie the dry regions, interspersed with land of high altitude and low temperatures.

Climates Along the Pacific

Along the Pacific lie two distinct types of climates. To the north, generally following the area marked "Year Round", is a marine climate with rather cool summers, mild winters and small annual range of temperature. To the south, in the region where many date lines converge, is found a climate with characteristics similar to regions adjacent to the Mediterranean.

Thus the date lines indicate graphically the astonishing variety of climates, ranging from sub-tropical to semi-arctic, found in the United States.

The table facing the map, and covering 100 cities, gives the definite beginning date in the larger cities.



Galloway

Electric Heating of Residences

In spite of its obvious advantages, the use of electricity for heating has been limited by its high relative cost. One of the most favorable markets for electric heating both from the standpoint of electric cost and climate is the State of Washington. This article presents data on the cost of installing and operating an electric heating system in a better class residence in Seattle, Washington

CONDITIONS both as to climate and cost of electric power are more favorable to the development of electric space heating in the Puget Sound area and in the lower Columbia and Willamette Valleys than elsewhere in the United States. Already these sections contain many installations where electric power is used for winter heating. Recently a bulletin (No. 93) entitled "Electric Power Markets in Washington" and published by the University of Washington, Seattle, summarized an investigation in the electric heating of residences under climatic conditions existing in Seattle. The author of the bulletin is Carl Edward Magnussen, director of the Washington Engineering Experiment Station, under whose direction the investigation was made. As a result of this study it is concluded that electric heating of residences may be a major factor in the power industry in the northwest. Included in the report are detailed calculations tending to show that $684 worth of heating equipment would be required to equip the average Class A residence in Seattle with a storage system for off-peak operation using electric power.

It is noted that the seasonal range in temperature, the length of the annual heating period, humidity, and other climatic factors, as well as the relative cost of electric energy to the cost of fuels for heating, are all factors in the problem of electric space heating, and must be considered in finding a solution for a given locality.

The energy requirements for space heating are largely dependent on the climatic conditions of the given locality. Therefore, the relative cost or economic practicability of electric heating, in comparison with the corresponding cost of heating by coal or other fuels, differs widely in cities or regional areas having marked differences in temperature range and other climatic factors. The electric power rates which determine the cost of the electric energy required for heating are, in all cases, of primary importance. On a cost basis, electric power rates higher than ½c per kw-hr. practically prohibit the use of electric energy for residence heating.

In Seattle the daily and annual ranges in temperature changes are comparatively very low, and the heating season is long, extending over at least nine months of the year. Therefore, the residence heating daily and annual load factors would be comparatively high, a basic requirement for establishing low electric power rates on a sound economic basis.

For basic engineering data the Montlake District in Seattle was selected as a typical residence area. Two feeders, one from the City Light Department and the other from the Puget Sound Power & Light Co., carried domestic service load, with such additional commercial load as would normally be expected in a typical residence area.

The following design data give quantitative values that comply with the requirements for electric heating of residences:

(a) Average home in the District will require energy for heating at the rate of 94,000 B.t.u. per hr. when the outside temperature is 10F. This is equivalent to 0.5 kw-hr. per hr. per degree F difference in outside and inside temperatures.

(b) The house-heating period is taken from 6 a.m. to 10 p.m., or 16 hr. per day.

(c) It is proposed to operate the heat storage tanks as a closed hot water system. The temperature range of the water is up to a maximum of 250F, which corresponds to a tank maximum pressure of 15 lb. per sq. in. In the computations the heat storage temperature range is assumed to be from 100F to 250F.

(d) Tank Dimensions. The outside dimensions of the water storage tanks as used in the computations are: 30-in. diameter; 60-in. height. Three tanks are interconnected and used as a unit. Total capacity of the three-tank unit: 73.5 cu. ft., or 550.5 gal., or 4600 lb. of water.

(e) Electric Heating Units. For normal year temperature conditions three units met the requirements and are used in the computations, viz.: two units of 3.0 kw. each; one unit of 4.5 kw.; or a total installed capacity of 10.5 kw. For installations that would supply sufficient heat during practically all of the cold spells or abnormally low temperature periods four units would be necessary and are used in the computations, viz.: two units of 3.0 kw. each; two units of 4.5 kw. each; or a total installed capacity of 15 kw. The above set of four units, having a total capacity of 15 kw., forms the basis of the computations covering the abnormal cold spell extending continuously for 24 days in January, 1930, the longest sustained period of below-freezing temperature in Seattle of record, 1891-1937.

(f) Automatic Control of Electric Heating Units. In order to secure the desired "partly off-peak" heating schedule, an automatic control must be installed in each residence. A number of automatic control devices and circuits are on the market, from which selection could be made that would give satisfactory results. In essence, the control would be based on: (1) The temperature of the water at selected points in the storage tanks; (2) a time-clock operating on a set "off-peak" load schedule arranged primarily to improve the load factor; and (3) the outdoor temperature at 10:30 of each day. It has been found that the 10:30 a.m. outdoor temperature quite consistently bears a fairly direct relation to the heat energy requirements during the next 24 hr.

(g) Solutions. In obtaining solutions for the heat required under normal day temperature conditions as well as under abnormal cold spell periods, the computations were made hour by hour throughout the entire normal year, and similarly, hour by hour for January, 1930, which contains the longest period (24 days) of below freezing weather of record.

The computed monthly kilowatt-hour consumption for lights, appliances, ranges, and water heaters for an average Class A residence in the Montlake District is given for each month of the normal temperature year in Table 1. The corresponding monthly cost data shown in the same table are based on the current rates in Seattle for present electric energy consumption. The computed energy consumption for heating by electricity is given in the third column of the table, but the cost of kilowatt-hours required for heating in the fourth column is based on a special rate of 3.5 mills per kw.-hr.

Monthly electric power rate schedule in Seattle is: from 0 to 40 kw-hr. at 5c; next 200-kw-hr. at 2c; above 240 kw-hr. at 75c. For abnormally cold years more heat would be required, and therefore the electric energy consumption and the cost would be greater than given in Table 1.

The cost of the assembled electric heating plant will depend on many factors that cannot at present be definitely predetermined. New and improved forms of automatic control apparatus, in particular, will quite likely be developed.

TABLE 1—Monthly and annual electric-energy consumption and cost data for present service and electric-heating of average Class A residence, Montlake District, Seattle.

Month of Year	Lights, appliances, ranges and/or water-heaters		Electric-heating. Computed values Special heating rate		Complete electric-power service, including heating of house	
	Consumption Kw-hr.	Cost $	Consumption Kw-hr.	Cost $	Consumption Kw-hr.	Cost $
June, 1935	322	6.62	...	...	322	6.62
July, 1935	292	6.39	...	...	292	6.39
Aug., 1935	311	6.53	...	...	311	6.53
Sept., 1935	348	6.81	1,612	5.64	1,960	12.45
Oct., 1935	328	6.66	3,200	11.20	3,528	17.86
Nov., 1935	324	6.63	4,315	15.10	4,639	21.73
Dec., 1935	310	6.52	5,600	19.60	5,910	26.12
Jan., 1936	320	6.60	6,020	21.07	6,340	27.67
Feb., 1936	309	6.52	5,140	17.99	5,449	24.51
March, 1936	295	6.41	4,680	16.38	4,975	22.79
Apr., 1936	311	6.53	3,660	12.81	3,971	19.34
May, 1936	316	6.57	2,450	8.58	2,766	15.15
Year	3,786	78.79	36,677	128.37	40,463	207.16

Steam Traps and Their Characteristics

4.—(Conclusion) Calculations for Steam Trap Capacities

By T. NAPIER ADLAM†

The quantity of condensate which a steam trap must handle at peak is frequently much greater than a consideration of average conditions would reveal. Here the author solves some problems by examples showing how the necessary capacities may be estimated.

THE amount of heat transmitted through a steam pipe immersed in water cannot be obtained by any simple calculation as the rate of transmission depends upon many factors. It depends upon the

(a) Actual temperature and pressure of the steam;
(b) Length of the coil;
(c) Diameter of the pipe in coil;
(d) Velocity of the water over the coil;
(e) Whether the pipe coil is vertical or horizontal;
(f) Inlet and outlet water temperatures, and
(g) Diameter of the battery or bank of coil tubes.

It also depends upon the metal used in the pipes and on how clean the coil is maintained.

Without going into the many factors involved in allowing for the variable conditions just enumerated, Table 1 gives the approximate transmission from the various commercial sizes of wrought iron pipe when immersed in water.

The figures are based on clean, wrought iron tubes with full steam pressure maintained the entire length of the coil and can be used for calculating the size of a steam trap. However, to prevent disappointment if calculating the output from a coil, a sufficient margin should be allowed for (a) incrustation of pipe surface and (b) a drop in steam pressure according to the length of coil, so that the average pressure in the coil should be taken and not the initial or main line pressure. Thus

(a) For incrustation, any factor down to 50% efficiency should be allowed;

(b) This depends upon length of coil, but an average steam pressure in the coil of 25% below the initial steam pressure may be taken for calculating heating value.

When deciding on the trap size, due allowance must be made for the drop in pressure through the coil, as the actual pressure on the trap will not be the same as the initial steam pressure in the supply pipe.

Table 1 is based on a temperature rise of 40F to 140F. Table 2 should be used for other final temperatures.

If pipes other than wrought iron are used, multiply the figures from Table 1 by the factors in Table 3.

†Chief Engineer, Sarco Co., Inc.

TABLE 2—MULTIPLYING FACTORS FOR VARIOUS OUTLET TEMPERATURES

(Multiply the heat emission from Table 1 by the factor below the given final water temperature)

Final Temp., F....	100	120	140	160	180	200	212
Multiplying Factor	1.30	1.14	1.00	0.88	0.76	0.64	0.54

TABLE 3—MULTIPLYING FACTORS FOR VARIOUS KINDS OF PIPE

(Multiply the heat emission from Table 1 by the factor opposite the given kind of pipe)

Wrought Iron	1.00
Brass	1.35
Copper	1.45
Cast Iron	0.81

Method of Calculation

EXAMPLE 1. Calculate the condensation from a coil having 55 ft. of 2-in. copper pipe with steam at 75 lb. pressure and water raised from 40F to 180F.

From Table 1, find that 2-in. wrought iron pipe at

TABLE 1—HEAT EMISSION OF IMMERSED PIPE

(B.t.u. given off per hour per running foot of wrought-iron pipe with inlet water at 40F and outlet water at 140F.)

Steam Pressure (Gage)	Pipe Diameter, Inches						
	¾	1	1¼	1½	2	2½	3
	Heat Emission, B.t.u. per Foot per Hr.						
1	4,050	5,950	7,150	8,160	10,500	12,700	15,000
2	4,300	6,300	7,500	8,600	11,100	13,400	15,700
5	5,000	7,300	8,800	10,000	13,000	15,600	18,400
10	6,000	8,800	10,600	12,100	15,600	18,800	22,000
20	7,500	11,000	13,200	15,100	19,500	23,500	28,000
30	8,900	13,100	15,700	18,000	23,200	27,800	33,000
40	10,200	14,800	17,800	20,400	26,400	31,700	37,500
50	10,800	15,800	19,000	21,800	28,000	33,700	39,800
75	13,100	19,200	23,100	26,500	34,200	41,000	48,200
100	14,600	21,400	25,700	29,400	38,000	45,600	53,600

TABLE 4—HEAT EMISSION OF BARE PIPE IN AIR

(B.t.u. given off per hour per running foot per degree difference in temperature between steam and air)

Temp. Diff. between Steam and Air	Pipe Diameter, Inches							
	¾	1	1¼	1½	2	2½	3	4
	Heat Emission, B.t.u. per Foot per Hour							
50	0.58	0.68	0.82	0.94	1.22	1.46	1.68	2.76
75	0.61	0.72	0.87	1.00	1.29	1.55	1.78	2.92
100	0.65	0.77	0.93	1.06	1.37	1.66	1.89	3.12
150	0.71	0.84	1.01	1.15	1.49	1.80	2.06	3.40
200	0.79	0.94	1.13	1.28	1.56	2.02	2.30	3.80
250	0.87	1.03	1.25	1.41	1.82	2.20	2.52	4.15
300	0.96	1.14	1.37	1.56	2.02	2.42	2.80	4.60

75 lb. pressure gives off 34,200 B.t.u. per ft. run when raising water to 140F. From Table 2 the factor for a final temperature of 180F is 0.76, and for copper find from Table 3 a factor of 1.45. Therefore, 55 ft. of 2-in. pipe gives off 34,200 × 55 ft. × 0.76 × 1.45 = 2,070,000 B.t.u. per hr., or approximately 2,070 lb. of condensate per hour.

It must be remembered, however, that if a steam trap has to be sufficiently large to deal with the maximum load it must take care of the peak, which takes place when all the water is cold. From Table 2 it will be seen that with a final temperature of 100F only, the condensing rate is 1.30 compared with Table 1 at 140F. Therefore, the peak rate when the water is cold will be at least 50% more than that for 140F. Add 50% to 2070 lb. per hr. and obtain 3105 lb. per hr. Then again, instead of assuming the pressure at the trap to be 75 lb. for maximum load it is more likely to be only 50% of this when the peak takes place. A trap should, therefore, be rated at not less than 3500 lb. per hr. at a pressure differential of not more than 40 lb.

There will be many instances where the steam pressure will be fairly well maintained but unless some degree of certainty is associated with the problem it is not safe to assume it, especially with a long coil.

EXAMPLE 2. Calculate the condensate load for a trap to deal with a heater raising 2500 gal. of water per hour from 40F to 160F and then calculate the amount of 2-in. brass pipe necessary to heat the water at 50 lb. steam pressure.

2,500 gal. × 8.3 = 20,750 lb. per hr.

20,750 lb. × 120F rise = 2,490,000 B.t.u. per hr.

2,490,000 ÷ 1000 (since 1 lb. of steam gives approximately 1000 B.t.u. when condensed into water) = 2490 lb. of condensate per hour.

Here again, it is necessary to take care of peak load conditions and a possible drop in steam pressure, so that it would be advisable to supply a trap capable of dealing with at least 4000 lb. per hr. at 35 lb. pressure.

To heat 2500 gal. of water 40F to 160F requires 2,490,000 B.t.u. per hr. From Tables 1 and 2, find that with steam at 50 lb. a 2-in. wrought iron pipe will give off 28,000 × 0.88 = 24,600 B.t.u. per hr. per ft. run. From Table 3, brass gives off 35% extra; therefore,

2,490,000 ÷ 24,600 × 1.35 gives approximately 77.8 ft. of 2-in. pipe.

To take care of an average lower steam pressure in the coil and for possible incrustation of pipes, it would be wise to allow at least 40% additional pipe and, therefore, install not less than 110 ft. of 2-in. brass pipe.

EXAMPLE 3. Calculate the condensate load for a trap to heat 500 gal. of oil per hour from 50F to 180F, with steam at 100 lb. pressure. 500 gal. of oil with a specific gravity of, say, 0.91 gives

500 × 8.3 × 0.91 = 3775 lb. of oil per hour.

3775 lb. of oil from 50F to 180F with a specific heat of 0.49 = 3775 × 130F × 0.49 = 240,460 B.t.u. per hr. or 240 lb. of condensate per hour.

Allowing for peak loads and drop in pressure, it would be advisable, in this instance, to install a trap to deal with at least 400 to 500 lb. an hour with steam at 80 lb. pressure.

Drying Rooms and Air Heaters

Where pipes are installed for heating air, the heat given off depends very much upon the location and the velocity of air over the pipes. A large coil of pipes will be very ineffective unless some means is provided for moving the air quickly over the surface of the pipes. Then again, much will depend upon whether the surfaces can give off radiant heat in addition to convected heat.

For rough calculations it is possible to use simple factors but the heating-up load is generally large and needs serious consideration.

Table 4 gives the heat given off in B.t.u. per hour per foot run of bare pipe when installed in still air at various temperature differences between the steam and surrounding air.

Method of Calculation

EXAMPLE 4. Calculate the condensation load with a pipe coil containing 300 ft. of 2-in. pipe with 80 lb. steam pressure in a room at 150F.

From Table 5, find the temperature of steam at

TABLE 5—TEMPERATURE OF STEAM AT VARIOUS PRESSURES

Steam Pressure in Lbs. per Sq. In., Gage	1	2	3	5	10	15	20	25	30	50	60	80	100
Temperature of Steam, F.	215	219	222	228	240	250	259	267	274	298	307	324	337

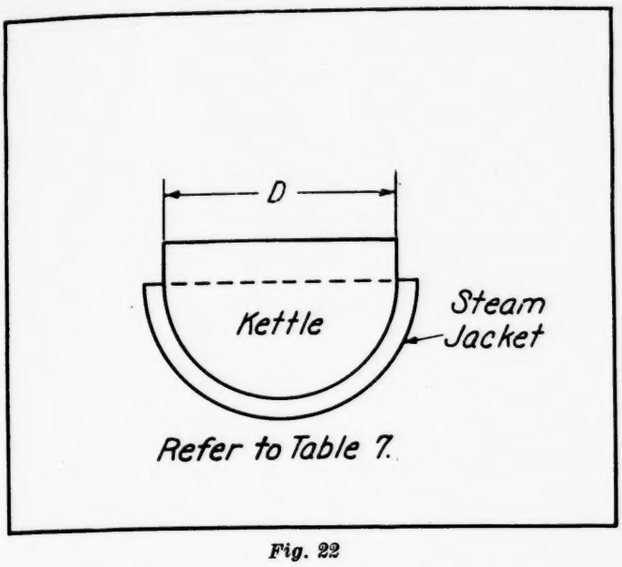


Fig. 22

80 lb. pressure is 324F, and since the surrounding air is at 150F the difference in temperature is 174F.

From Table 4, find that 2-in. pipe with 150F difference gives off 1.49 B.t.u. per hr. per ft. run and with 200F difference the rate is 1.56 B.t.u. per hr. For 174F difference the rate can be taken as the mean of 1.49 and 1.56, that is 1.52 B.t.u. per hr. per degree difference.

Therefore, the total load is 300 ft. × 174 × 1.52 = 79,300 B.t.u. per hr., which is equal to approximately 80 lb. of condensate per hour.

Seeing that when starting up, the whole of the iron has to be heated from cold, the initial condensation will be much greater than the steady load. Since 1 ft. of 2-in. pipe weighs approximately 3.6 lb. and the temperature is raised from say 50F to 324F, the heat absorbed will be 300 ft. × 3.6 lb. × 270F rise × 0.114 (specific heat) = 33,800 B.t.u. This coil should heat up fully in 3 min. so that the rate will be (33,800 × 60) ÷ 3 or 676,000 B.t.u. per hr. = 676 lb. of condensate per hour. Since there are a lot of pipe fittings to be heated up in addition to the pipe, the trap should be capable of dealing with at least 800 lb. per hr. to insure rapid heating up.

Similar calculation for any size pipe and condition can be made by using figures in Tables 4 and 5, but due care must be taken to allow for the heating up load which is generally two to three times the steady load.

Steam Jacketed Pans

When calculating the load for a steam trap to deal with steam jacketed pans or kettles, this will be found very problematical.

Table 6 gives the heat given off per square foot of steam heated jacketed surface exposed to water or other similar liquid. This, however, will vary according to the temperature of the liquid and how quickly the liquid can move over the heated surface.

For instance, 1 sq. ft. of steam heated surface with steam at 10 lb. will condense 42 lb. of steam per hour when the water is cold, but only 13 lb. per hr. when the water reaches boiling point. The trap has to take care of the peak load so that the lower rate of transmission bears no significance to the size of trap required.

Table 6 gives approximately the maximum rate of condensation per square foot of exposed surface in a steam jacketed pan or kettle, with cold water inside the steam at various pressures, provided the condensate is discharged as soon as formed.

TABLE 6—STEAM CONDENSED PER SQUARE FOOT OF EXPOSED SURFACE OF STEAM JACKETED KETTLES

Steam Pressure in lbs. per sq. in., Gage....	1	2	5	10	15	25	50	75	100
Pounds of steam Condensed per Hour...	10	20	30	42	50	58	80	100	115

TABLE 7—STEAM CONDENSING AREA OF JACKETED KETTLES

(Hemispherical surface jacketed to height of hemisphere only. See Fig. 22)

Dia. of Kettle in Inches, D.	Area of Condensing Surface in Sq. Ft.
18	3.54
20	4.37
22	5.24
24	6.30
30	9.85
32	11.2
34	12.6
36	14.1
40	17.5
42	19.3
46	23.1
48	25.2

Method of Calculation

EXAMPLE 6. Calculate the condensate load for a trap connected to a steam jacketed pan 36 in. dia. and 30 in. deep inside with jacket brought to within 6 in. of top of pan. Steam pressure, 50 lb. per sq. in.

Steam heated surface exposed to water with 3 ft. dia. hemispherical vessel = 3 × 3 × π ÷ 2 = 14.1 sq. ft. for spherical portion, plus vertical sides which will be π × dia. × depth.

The depth of pan is 2 ft. 6 in., which leaves 12 in. vertical surface all around, but since the water is 6 in. down from the top only 6 in. of the depth will be useful. Therefore, side surface = 3 ft. × π × 6/12 = 4.7 sq. ft.; total surface 14.1 + 4.7 = 18.8 sq. ft.

From Table 6, find that 1 sq. ft. of surface at 50 lb. pressure will condense 90 lb. of steam per hour; therefore, the maximum rate will be 80 × 18.8 = 1504 lb. of condensate per hour which a steam trap should be capable of dealing with, with a margin for heating up metal pan.

The average condensation rate from start to boiling on these pans will be much less than the maximum rate, as can be readily seen from a glance at Fig. 22.

This concludes the series of articles of "Steam Traps and Their Characteristics."

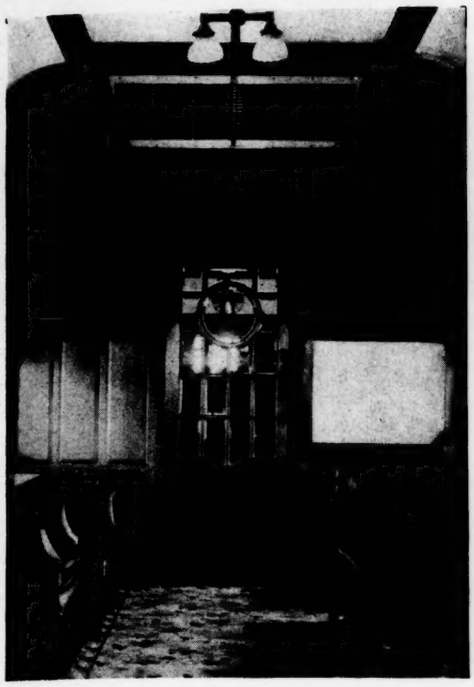
PICTURE PARAGRAPHS

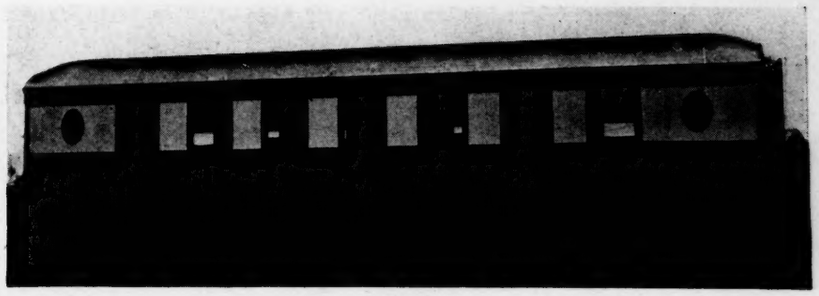
HEAT FOR THE ARCTIC. Eskimo women carrying 100-lb. bags of anthracite to shore from the Hudson Bay Company's steamship "Nascopie." Once a year the steamer carries the necessities of life to the outposts of the Hudson Bay Company, which has been active in Canada since 1670. Docking facilities for the steamer are available at very few points and much of the coal must be carried to shore in small boats.

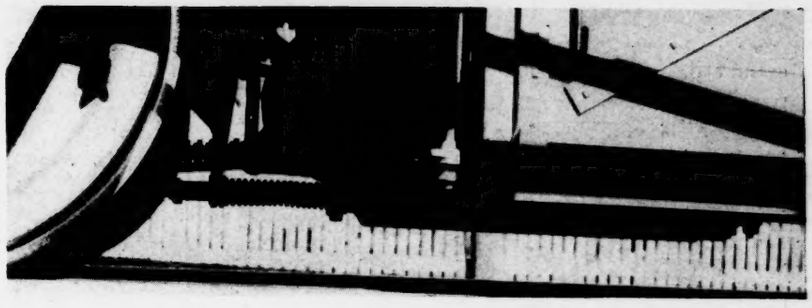
POLLEN STUDY FAVORS CONDITIONING. Prof. F. H. Hodgson, allergy department botanist at Roosevelt Hospital, New York, studies hay fever pollen gathered in an air conditioned room. His tests, conducted in cooperation with Carrier Corp., showed that a portable conditioner removed 99½% of pollen from pollen-saturated air.

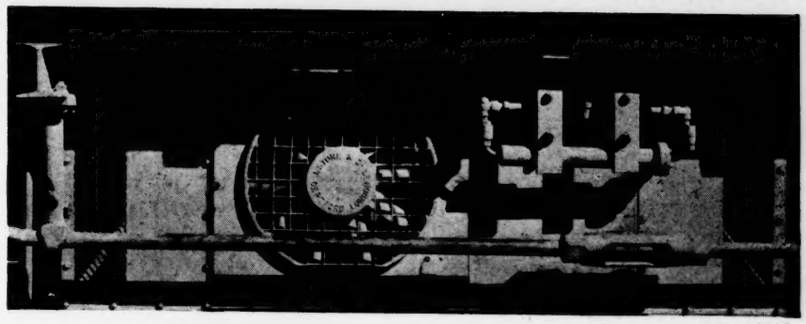
FROST CONTROL. To combat frosts which threaten California's citrus industry, growers use smudge pots. Recently G. W. Grable (above), California engineer, demonstrated his Conveyco. Provided by an oil burner, hot air is fed to the oscillating fan, driven by a Ford motor. Thence, it is blown over areas up to 10 acres, maintaining temperatures above 27F. Cost per acre per hour, 10c. Wide World Photo.

CIRCULAR DOME FOR AIR SUPPLY. Air is discharged from the 12 grilles of the dome at Patten's Restaurant, Boston.

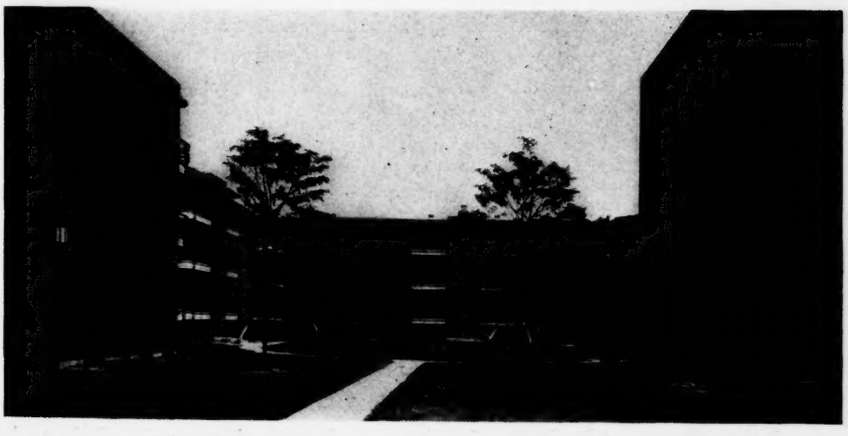




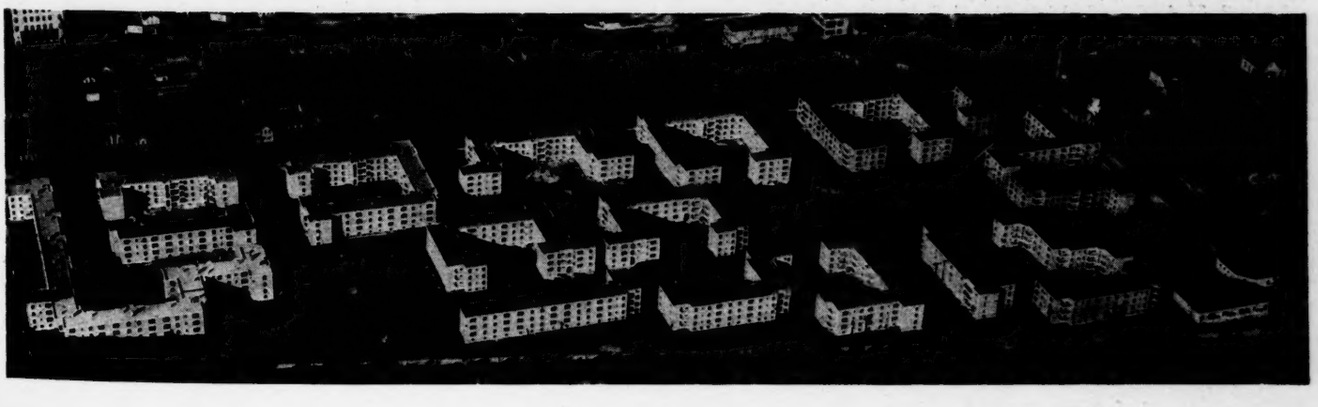




TRANS-AUSTRALIAN RAILWAY CARS CONDITIONED. (Upper Right) One of the Australian air conditioned cars. (Center Right) The compression unit drive beneath the car. (Lower Right) Closeup of the compression unit. (Above) The air conditioner unit is mounted in the roof of the car behind the grille and over the door between the car compartments.



HOUSING IN CLEVELAND. (Below) Air view of Cedar Central Apartments, a PWA $3.4 million low rent housing project. (Left) A section of the Cedar Central Apartments. Rents range from $18 per month for three, to $23 for five rooms. 650 dwelling units are provided in this project which wiped out 18 acres of slum area.



INDUSTRIAL EXHAUST VENTILATION

Principles of Exhaust Hood Design

THE orifice through which contaminated air enters an exhaust system is called a hood. Its importance cannot be overestimated. If the hood is proportioned poorly nothing done later in the system can compensate for its inadequacy. The penalties for indifferent hood design are excessive size and first cost of the system, high power bills and, probably, unsatisfactory dust control.

The purchaser as well as the designer should have a working knowledge of hood principles. The contractor's hood drawings should be checked against known peculiarities of machinery and operating conditions. It is seldom that an outside engineer can determine the operating practicability of a hood as successfully as can the purchaser's engineer.

By JOHN L. ALDEN

Hood Types

The general classes of exhaust hoods are (1) machine hoods, (2) top or canopy hoods, and (3) booths or enclosures. Machine hoods exhaust contaminated air and coarse refuse at the source and therefore capture the dust before dispersion takes place. For this reason they produce a given degree of dust control more cheaply than does general exhaust ventilation. Booths or partial enclosures generally house operations difficult to hood such as spray painting, welding and swing frame grinding. The principal application of canopy hoods is the removal of smoke, fumes, and vapors lighter than air.

General Rules for Design of Machine Hoods

The following principles of dust control at the source will meet most requirements. They are amplified in succeeding paragraphs.

1. First, reduce the cause of contamination as far as possible by modification of the process, machine or material before designing hoods.
2. Place the hood as close to the source of contamination as possible, preferably enclosing it.
3. Locate and shape the hood so that the dust particles thrown from the source are directed into the mouth of the branch pipe.
4. Cause air to flow past the dust source and into the hood with a velocity at the point of dust origin greater than the velocity of escape of the particles.
5. So locate the hood that the operator is never between the dust source and the hood.

Machine hoods intended for the reduction of health hazards require somewhat different design technique than do those installed for refuse removal purposes. The distinction lies in the size of the dust particle which each type is designed to handle. Dusts promoting occupational disease are microscopic in dimensions whereas industrial refuse may include a high percentage of large and heavy bodies.

Dusts

It is believed that the practical maximum limit of inspired dusts cannot be much over 20[1] microns in longest dimension. In fact, relatively few particles over 10 microns are found in silicotic lungs. Some authorities doubt the retention in the lungs of substantial quantities of dusts finer than 0.5 microns. Regardless of the question of a possible lower limit of dangerous size, there is certainly a maximum limit and that limit is very small indeed. Expressed in shop terms, the dangerous particles are all substantially less than 0.001 in. long. It appears that numbers of particles rather than total weight of dust is significant in the evaluation of health hazards. Thus, it is reported that of certain foundry dusts investigated, 99%, by number of particles, were of dangerous size, 10 microns or finer, whereas these particles comprised but 27% of the total weight of the samples.

The author makes no pretense of treating the pathological aspects of dusts and fumes. It is recommended strongly that the more recent literature cited in the bibliography be consulted. It must be recognized that knowledge of dusts and their effects is far from complete. The field is being cultivated intensively, however, and much valuable material is being published currently by Drinker, Bloomfield, Hatch, Greenburg, and others. The engineer concerned with dust control in hazardous industries will do well to inform himself of the latest work of such men.

Relative Dust Hazard

While authorities differ as to the harmfulness of certain industrial dusts, a few are known definitely to be hazardous. Chief among these is silica, occurring commonly as quartz. It is encountered in industries as dissimilar as granite cutting and hard-rock mining on the one hand and those employing abrasive processes such as sand blasting and grinding on the other. Asbestos, also, is known to produce pulmonary disability.

The toxic dusts, including lead, mercury, arsenic and others, are hazardous when inhaled. In fact, there is considerable evidence that the likelihood of poisoning through inhalation may be greater than that through food contamination.

[1] 1 micron = 1/1000 millimeter = 0.00003937 in.

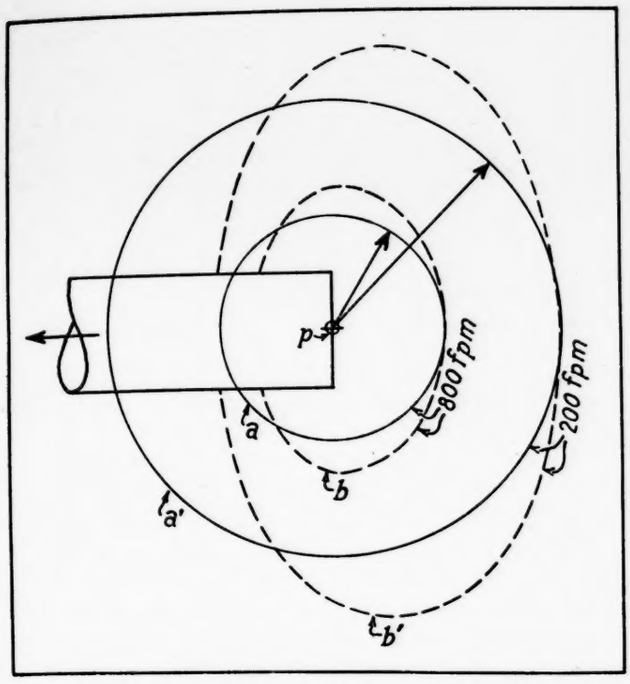


Fig. 10. Velocity contours of point source of suction and of open pipe mouth.

Coal dust alone is believed not to produce disabling fibrosis. Calcium and magnesium carbonates as represented by limestone, marble, dolomite and magnesite have been shown to be comparatively harmless. The vegetable dusts such as cotton, jute, hemp and wood also are in this category. However, lacking positive evidence that a given dust is not harmful, it is best to assume that it is dangerous and to provide adequate protection.

Dispersion of Dusts

The manner and degree of dispersion of dust is a function of particle size. Large particles thrown from a wheel or cutter may be distributed over a wide area by virtue of their kinetic energies and without assistance from air currents. Small particles, on the other hand, are dependent entirely upon air currents for their dispersion. The mass of a tiny particle is so small and the kinetic energy so little that it is incapable of sustained flight. It loses velocity rapidly and cannot be projected far from the point of generation.[2]

Fine dusts in suspension drift with the general air currents. Their dispersion depends almost entirely upon drift. Fine dusts, therefore, must be controlled by controlling the flow of the entraining air. Coarse particles, on the contrary, are but little affected by local currents of mild intensity. Their dispersion by dynamic projection requires that the hood be placed, target-like, so that the particles are thrown directly into the pipe mouth.

Local Air Movements and Counteracting Velocities

Some evaluation of stray air currents is necessary before effective counteracting velocities can be determined. Convection currents from radiators, ovens and furnaces seldom exceed 25 to 75 f.p.m. Direct window drafts may be much more brisk but can be controlled by closing windows or by installing screens, baffles or deflectors. Flywheels, large pulleys and even abrasive wheels frequently cause disturbance over considerable area. Excessive machine vibration, particularly of large flat panel surfaces, often keeps in suspension dust which would settle otherwise. The first puff of dust-bearing air displaced from bags and barrels during gravity filling has been observed to escape at velocities as high as 250 f.p.m. If dust control currents are to be effective over an exposed dusty source the very minimum tolerable velocity toward the hood is 75 to 100 f.p.m. Even when aided by baffles or a partial enclosure, higher velocities often are required, even 500 f.p.m. and higher. To determine the minimum control velocity it is necessary to make some estimate of the escape velocities either from experience or by means of the exploring hood later described.

All suction openings tend to draw air equally from all directions and would do so in fact if the suction source were a point in space. With a point source of

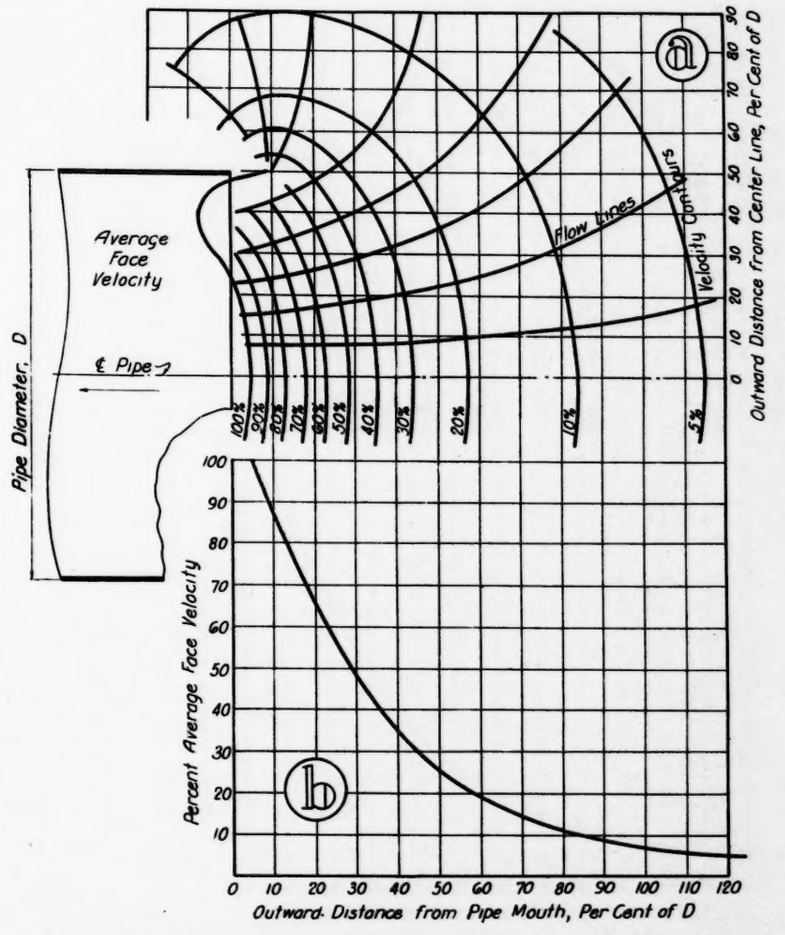
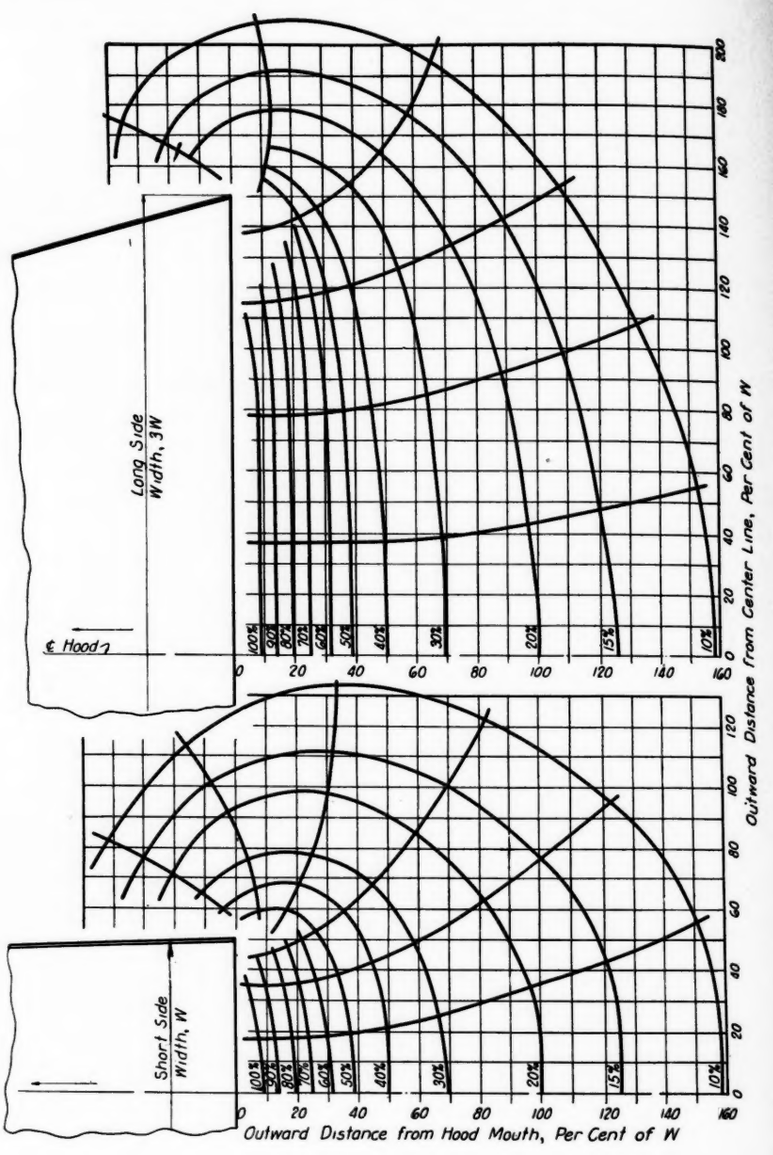


Fig. 11. Velocity contours and flow directional lines in radial plane of circular suction pipe.

[2]A 10 micron abrasive particle thrown from a wheel at 10,000 f.p.m. can fly about 1 in. in still air. At the same speed a particle 1/16 in. diameter may be thrown 100 ft.

Fig. 13. Velocity contours and flow directional lines in principal center line planes of rectangular suction hood with side ratio 1:3.


Long Side Width, 3W
℄ Hood
Short Side Width, W
Outward Distance from Center Line, Per Cent of W
Outward Distance from Hood Mouth, Per Cent of W

suction, the locus of all points of equal inward velocity would be a sphere. This sphere could be called a contour surface and the trace of the sphere on an intersecting plane a contour line. The latter would be a circle, of course. In practice a point source of suction is an impossibility and we have instead a hood and branch pipe of finite dimensions. The presence of these distorts the flow lines and the velocity contour surfaces so that the latter are no longer spheres but are bulged transversely of the hood axis. Fig. 10 shows a comparison between the circular velocity contour lines produced by a point source of suction, p, and the flattened, oval contours produced by the finite hood. The inward velocities at all points on the circular contours a and a′ are identical with those on the oval contours b and b′.

The region in the vicinity of the hood mouth may be explored with a small impact tube by which both the velocity and direction of flow may be found. These may be plotted as in Fig. 11a which shows the velocity contours and flow directional lines lying in a longitudinal center line plane of a round pipe or hood.[3] The direction lines represent the paths of air particles entering the hood. Because of the symmetry of round hoods, a single diagram represents all of the contours and direction lines of all centerline planes.

[3]The principal work in this field has been reported by Dallavalle and Hatch in the following paper and others: "Studies in the Design of Local Exhaust Hoods," by J. M. Dallavalle and T. Hatch, A.S.M.E. Transactions, Vol. 54, 1932.

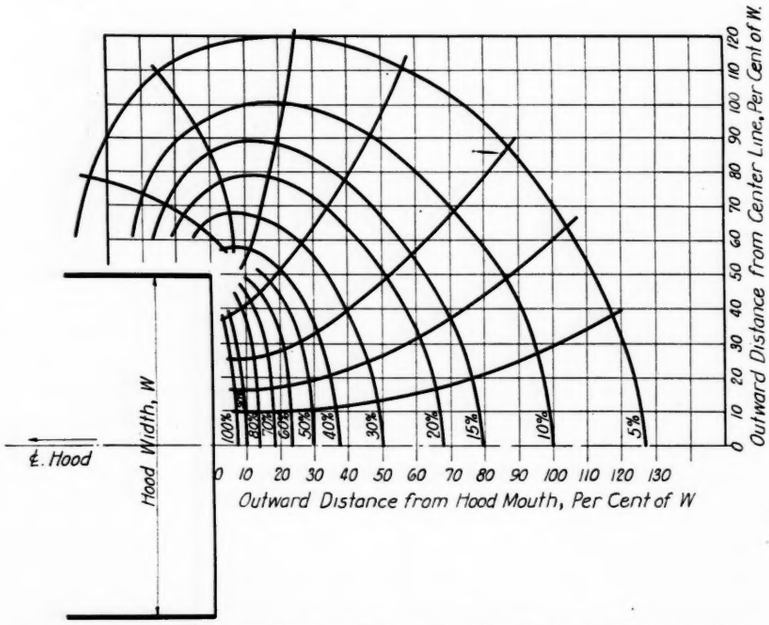


Fig. 12. Velocity contours and flow directional lines in center line plane of square suction hood.

Inspection of Fig. 11a discloses that the velocity drops rapidly as the distance from the hood increases. This is more graphically illustrated in Fig. 11b in which distances are expressed as percentages of hood face diameter and velocities as percentages of hood face average velocity. At outward distances greater than 0.5 diameters, the velocities are closely inversely proportional to the squares of the distances from the plane of the hood face. Fig. 11 applies to all round suction openings regardless of size.

Effectiveness of Suction Openings

From Fig. 11 it is evident why a suction hood cannot be expected to influence the behavior of a dust particle at a considerable distance from the hood mouth. Assume a dust particle flying in space and requiring an air velocity of 1000 f.p.m. to deflect it into the hood. With a 6-in. diameter pipe let the hood mouth be but one diameter, or 6 in., away from the particle and let the

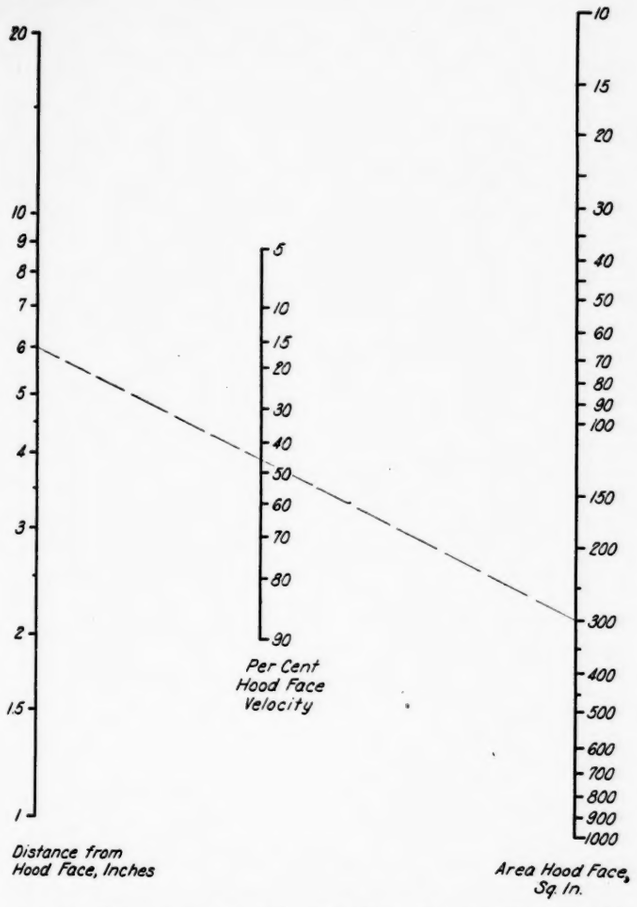


Fig. 14. Nomogram for determination of center line velocity of suction hoods.

face velocity be 4000 f.p.m. Then note from Fig. 11b, at 100% on the horizontal axis, that at 6 in. from the hood the velocity will be 7% of 4000 f.p.m. or 280 f.p.m. This is plainly insufficient to capture the particle. The hood must approach the flying particle to within a distance of 3 in. or less before the kinetic energy of the latter can be counteracted by the inrushing air.

The zone of influence of exhaust currents is narrowly restricted to the immediate region of the hood face. This is in sharp contrast to the ability of a pressure jet to "reach out" to relatively great distances from a nozzle. Consequently, exhaust hoods must be placed very close to the source of dust; must embrace it; or must be placed so that the natural trajectories of the dust grains terminate in the hood mouth.

Typical Hood Contours

Figs. 12 and 13 show contour and direction lines along the principal axial planes of square and rectangular hoods. While the location of the contours along the axis varies somewhat with the shape of hood, it will be observed that the contours of all shapes of simple openings are similar in shape. When the hood opening is round or square, a simple curve such as Fig. 11b is sufficient to define its center line characteristics. Rectangular hoods with elongated openings produce elongated contours conforming somewhat to the shape of the opening. It is possible, of course, to explore the whole field of influence of a hood and to prepare a three-dimensional model of velocities. Experience shows, however, that contours drawn for the two axial planes perpendicular to the hood sides are sufficient for design and application purposes.

Relation of Face Area to Velocity

Dallavalle's experiments have demonstrated that center line velocities are affected not only by the distance from the hood face but also by the hood face area. A given contour is located farther from the hood face with a large hood than with a small one, everything else being equal. Dallavalle derives an approximate relation between face area, velocity and distance as follows:

$$y/(100 - y) = 0.1\ a/x^2\text{, where}$$

y = velocity in % of face velocity
a = hood face area
x = distance from hood face

Both a and x are expressed in the same linear units. The nomogram, Fig. 14, has been constructed from this equation to simplify calculation of the center line velocity.

Summary of Hood Face Characteristics

Several conclusions can be drawn from the experimental studies just discussed and from the typical contour diagrams.

1. All suction openings regardless of size or shape tend to draw air equally from all directions. Departure from this ideal is caused by the presence of obstructions to flow such as the hood and pipe and by the fact that the suction source is a plane surface rather than a point in space.
2. The tendency for the contour surfaces to approach sphericity increases with the distance from the hood.
3. For a given hood shape, regardless of face velocity, the shape of the contour lines is nearly identical for all hood sizes.
4. When velocities are expressed in terms of face velocity and distances in terms of hood dimensions, a single pattern of contours is representative of all hoods of the same shape.
5. Large hoods are effective over greater distances than small hoods. Contours representing the same percentage of face velocity lie farther from the hood face.
6. Velocity contours are not far from parallel to the hood face over the area projected by the face.

The chief value of this discussion of hood flow characteristics is the emphasis it places on visualization of what happens when a hood is subjected to suction. The designer will have but little occasion to plot precise contours or flow lines. He will find that by study of the diagrams and by locating the intersections of the contours with the center line, he can draw freehand contours and flow direction lines which are sufficiently accurate for most purposes. Practice in drawing contours will stimulate the development of air flow "sense" to a considerable degree.

Effect of Hood Structure in Rear of Face

The hood face is seldom of the same shape as the cross section of the branch pipe. The two are joined by a tapered section or by box-like pieces. It has been

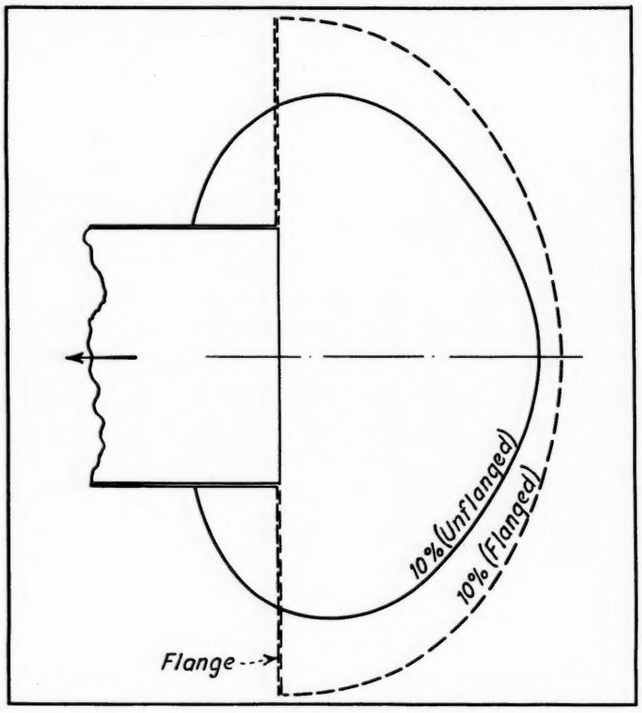


Fig. 15. Effect of hood flanges on velocity contours.

shown by Dallavalle and Hatch that the shape of the taper and its proportions have little or no influence on the shape of the velocity contours outside the hood mouth. It has an important bearing on the pressure loss at entry but this subject will be covered later.

Flanged Hood Faces

Flanges surrounding a hood opening as in Fig. 15 tend to push the velocity contours farther from the hood face by forcing air to flow from the zone directly in front of the hood. The flange reduces the flow from the ineffective regions. The flange width should be such that it intercepts the 5% contour line of the unflanged hood if possible. If so constructed, the 30% contour will be pushed outward about 14% and the 10% contour about 9%. For a given velocity in the effective zone, the flanged hood requires only about 70% of the air volume of an unflanged opening.

Influence of Adjacent Planes

A hood lying on a large flat surface, such as a machine table, requires only about 75% of the air volume of a similar hood in space to produce the same effective velocity. Such a hood is shown in Fig. 16. Its velocity contours are identical with those of one half of a hood of twice the depth of opening. The designer

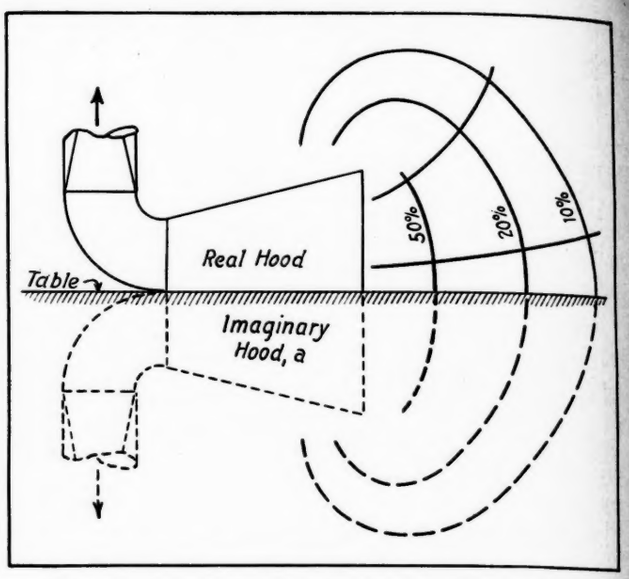


Fig. 16. Velocity contours of hood resting on table.

may imagine an identical hood, a, shown dotted, adjacent to the hood in question. The velocity contours of the latter are one-half of those of the combined openings of the real and imaginary hoods.

Hoods for the Capture of Coarse Particles

Thus far the discussion has been confined to a type of machine hood whose chief function is to create a general air flow away from the workman and past the dust source. Its principal effectiveness is in removing air contaminated with dust of pathologically important dimensions. Large particles thrown with considerable speed and possessing substantial kinetic energy cannot be captured economically by this type of hood remote from the dust source unless the particles follow a single predictable sheaf of trajectories. Therefore most machine operations producing large quantities of dust and refuse are provided with enclosing hoods if possible. A single rule covers the design of most hoods for this purpose:

Design the hood so that the material is thrown by the machine into the zone of highest air velocity, preferably the mouth of the branch pipe.

The influence of this principle will be seen in many of the hoods shown in succeeding illustrations. Certain exceptions will be mentioned wherein a departure is justified by operating or maintenance considerations. It should be emphasized that a hood designed in accordance with this rule will carry off not only the large particles but also the minute and hazardous ones.

Tank Heater Ratings Based upon Physical Dimensions

AN adequate supply of hot water is of primary importance in any installation. It is, therefore, manifestly advisable that the equipment selected be of a size sufficient to ensure an adequate supply at all times.

After making extensive tests of all types and sizes of tank heaters, engineers of the Anthracite Industries laboratory have developed a formula to predict tank heater ratings based upon the physical dimensions of the equipment.

The formula is: $R = 22d\,(D-3)\,\sqrt{H}$, where

R = rated hourly output in gallons heated 100F
d = grate diameter in inches
D = firebox depth in inches (For calculation, do not use a figure of more than 9 in. for pea, or 12 in. for chestnut size of anthracite.)
H = heating surface in square feet

The tank capacity, being three times the hourly rating, may be computed on that basis.

New England Bus Line Conditions Terminal

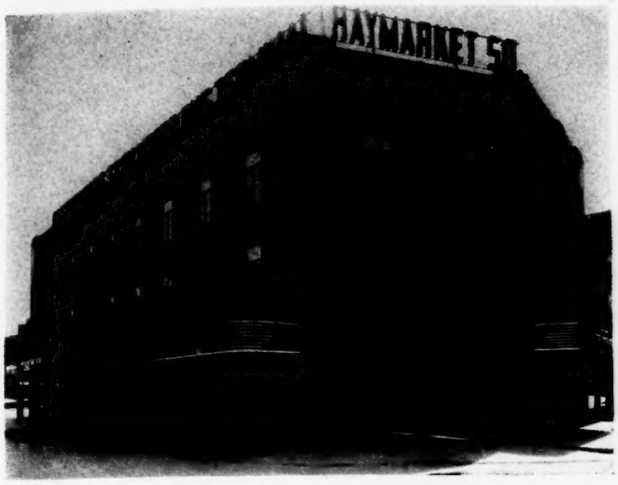


Fig. 1. Exterior of terminal from Haymarket Square. One hundred and twenty-five buses a day are loaded here.

Fig. 2. One side of the busway, showing air conditioning grilles along edge of passenger walk. The grilles are designed to introduce enough air to overcome effects of gasoline fumes if desirable. Ordinarily natural ventilation makes such supply unnecessary.

Fig. 3. A section of the waiting room, with dining counter. Odors from the kitchen are carried off through the hood. An air conditioning grille may be seen in the dado at upper left.

RECENTLY completed in Boston for the Eastern Massachusetts Street Railway is one of the first completely air conditioned bus terminals in the country, perhaps the handsomest bus terminal building in New England. This line serves 71 towns and cities in the eastern part of the state, and is said to have the largest fleet of buses of any city transportation company in the United States. Service on the north from Boston is handled through the new terminal, traffic totaling between six and seven thousand passengers daily.

It was desirable to provide an adequate terminal and comfortable waiting room at Haymarket Square, facing heavy foot traffic with a subway entrance to elevated and railroad connections. The company headquarters were also combined with the terminal.

The new building is three stories high with casement windows, a waiting room 120 ft. long, a dining space, a covered busway accommodating six buses lined up two abreast, and 29 offices on the upper floors, together with a basement for heating and air conditioning equipment.

Air conditioning equipment provides for summer cooling, winter tempering, with humidifying in winter, and year-round air filtering. Heating is supplied through an auxiliary radiator system with zone control, two semi-concealed radiators being placed under each window in the waiting room.

Air conditioning for the waiting room is furnished from basement equipment, and for the two upper floors by two units separately placed in two roof penthouses. Equipment supplying the waiting room includes a 15-ton direct expansion compressor. Air supplied the waiting room totals 5300 c.f.m., of which 2000 c.f.m. is drawn from outdoors.

The two upper floors combined require 24 tons of cooling, with a total air volume of 9000 c.f.m., of which 1800 c.f.m. is ventilation air. This system operates in two zones. A 20-hp. compressor in the basement supplies the roof conditioners.

A cooling tower on the roof, a Binks R-175 8 x 12 x 12 ft. unit with 150 g.p.m. capacity, 3-hp. circulating pump, and a 9 x 13 ft. pan, are used in common for the entire building. This is supplied with steel louvers to meet requirements of the city of Boston building department and weighs approximately 4100 lb. dry. and about 7900 lb. in operation. It is rated up to 35 tons of refrigeration and is equipped with Rotojet nozzles. All metal work except the collecting pan was galvanized after fabrication and is of copper bearing steel.

Some of the offices have no return grilles, having instead specially designed steel doors with louvers. Exhaust in this case is into the corridors and through the corridor returns. This type of door is located only on the two upper floors.

Contractors for the air conditioning system were the Lawton Engineering Co., Boston; for ducts, Rollins & Morse, Lynn, and for the cooling tower, Starkweather Engineering Co., Boston.

A New Chart for Comparing Fuel Costs

By PAUL D. CLOSE
Chief Engineer, The Celotex Corporation.

Which is the more costly: Coal at $10 per ton or oil at 7 cents per gal.? How do these compare with manufactured gas at 60 cents per thousand cubic feet? Questions of this character are being asked every day. This article and the chart which appears with it have been prepared to give you a quick answer to these questions. The chart is unusual in that it makes it easy to visualize the comparative costs of various fuels.

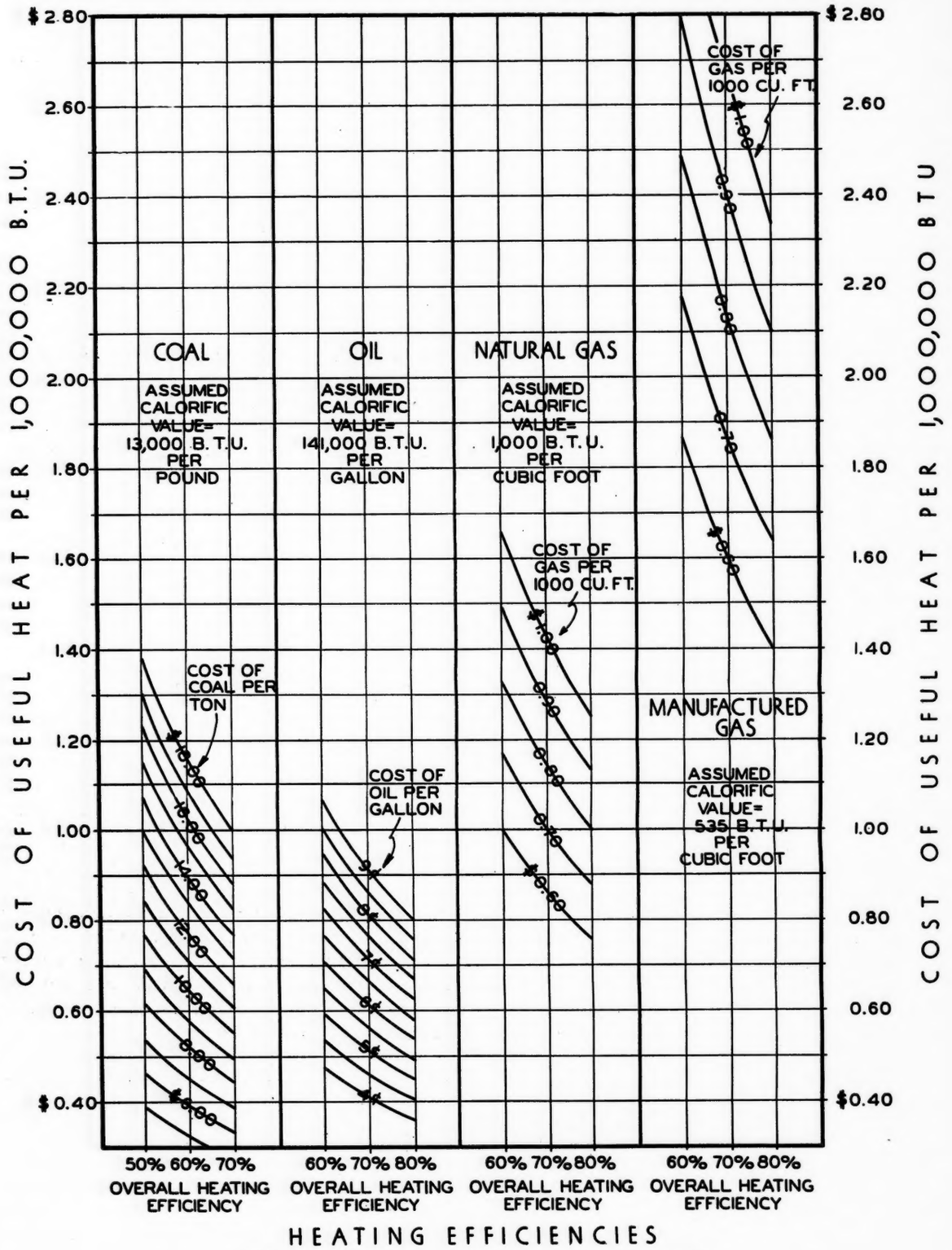


Fig. 1. Comparative heating costs of coal, oil and gas

IN order to compare heating costs of fuels, some common basis is necessary. A convenient unit is the cost per 1,000,000 B.t.u. of useful heat produced within the enclosure based on the assumed heating efficiency and the calorific value of the fuel. For the purposes of this article, the useful heat is considered to be the gross calorific value of the fuel minus the sensible and latent heat in the flue gases and any unconsumed fuel.

The *therm,* which represents a quantity of heat equivalent to 100,000 B.t.u. and which is used in the gas industry, is intentionally avoided for two reasons, namely, (1) because this unit represents a gross or maximum value of the fuel, whereas the net or useful value, based on the proper heating efficiency, is being considered and (2) the cost per 1,000,000 B.t.u. represents a more convenient figure to use in most cases than the cost per 100,000 B.t.u.

Comparative Costs of Fuels

The cost per 1,000,000 B.t.u. of useful heat for any specified fuel is of course determined by dividing the cost of the fuel by the number of B.t.u. obtained based on the calorific value and the heating efficiency. For example, if coal having a calorific value of 13,000 B.t.u. per lb. is utilized with an efficiency of 60%, each ton will contain 13,000 x 2000 x 0.60 or 15,600,000 B.t.u. of useful heat. At $10 per ton, the cost of useful heat per 1,000,000 B.t.u. would be $10.0/15.6 or $0.64. Costs of coal for various heating efficiencies and for the calorific value indicated are given in Table 1. As previously stated, the 50% efficiency may be regarded as a reasonable average value for hand-fired residence installations, whereas the 60% efficiency applies either to stoker-fired residences or hand-fired industrial jobs. Costs per 1,000,000 B.t.u. of useful heat for other efficiencies and calorific values may be determined in a similar manner.

Costs of useful heat per 1,000,000 B.t.u. for oil based on a calorific value of 141,000 B.t.u. per gal. and the efficiencies indicated are given in Table 2. The costs for manufactured and natural gas, based on assumed efficiencies of 60, 70, and 80%, respectively, are given in Table 3.

Graphical Comparisons

Comparative heating costs may be readily visualized by means of Fig. 1. For example, oil at 7 cents per gal. and a heating efficiency of 80%, which is a reasonable average value for oil-designed equipment, is approximately equivalent to 13,000 B.t.u. coal utilized with an efficiency of 60% and costing about $9.50 per ton, or coal of the same calorific value utilized with an efficiency of 50% costing $8 (+) per ton.

Natural gas at a rate of $0.60 per 1000 cu. ft. is comparable in cost for the same heating efficiencies to oil at 8½ cents per gal. The $0.60 natural gas rate represents the approximate general minimum for the United States for this fuel, whereas the oil rate of 8½ cents per gal. is the approximate maximum for this fuel, although these figures may be exceeded in certain localities. The average cost per million B.t.u. with 1000 B.t.u. natural gas would probably range between $1.10 and $1.20, whereas the average fuel oil cost would probably range between $0.65 and $0.75, as will be apparent from the second and third columns of Fig. 1. Coal costs vary over a somewhat wider range depending on the locality and type of fuel, but the average cost is probably slightly less than the average oil cost. Specific comparison may be made by means of Fig. 1. It is apparent at a glance that the average cost of useful heat with manufactured gas is approximately twice as high as the average cost with natural gas and roughly three times as great as with oil or coal.

In Chicago and surrounding suburbs, a mixed natural

TABLE 1.—COSTS OF USEFUL HEAT PER MILLION B.T.U.—COAL*

Cost of Coal (Dollars per Ton)	Heating Efficiency		
	50%	60%	70%
	Cost per 1,000,000 B.t.u., Dollars		
4	0.308	0.256	0.219
5	0.385	0.321	0.275
6	0.462	0.385	0.330
7	0.538	0.449	0.385
8	0.615	0.513	0.440
9	0.692	0.577	0.495
10	0.769	0.641	0.549
11	0.846	0.705	0.604
12	0.923	0.769	0.659
13	1.00	0.833	0.714
14	1.077	0.897	0.769
15	1.154	0.962	0.824
16	1.231	1.026	0.879
17	1.308	1.090	0.934

*Costs are in dollars per 1,000,000 B.t.u. of useful heat as produced in the building for efficiencies indicated.

Table based on coal having a calorific value of 13,000 B.t.u. per lb.

TABLE 2.—COSTS OF USEFUL HEAT PER MILLION B.T.U.—OIL*

Cost of Oil (Cents per Gal.)	Heating Efficiency		
	60%	70%	80%
	Cost per 1,000,000 B.t.u., Dollars		
4	0.473	0.405	0.355
4½	0.532	0.456	0.399
5	0.591	0.507	0.443
5½	0.650	0.557	0.488
6	0.709	0.608	0.532
6½	0.768	0.659	0.576
7	0.827	0.709	0.621
7½	0.886	0.760	0.665
8	0.946	0.810	0.709
8½	1.006	0.860	0.753
9	1.065	0.911	0.797

*Costs are in dollars per 1,000,000 B.t.u. of useful heat as produced in the building for efficiencies indicated.

Table based on oil having a calorific value of 141,000 B.t.u. per gal.

TABLE 3.—COSTS OF USEFUL HEAT PER MILLION B.T.U.—GAS*

Cost of Gas (Cents per 1000 Cu. Ft.)	Manufactured Gas[a]			Natural Gas[b]		
	Assumed Heating Efficiency			Assumed Heating Efficiency		
	60%	70%	80%	60%	70%	80%
	Cost per 1,000,000 B.T.U., Dollars					
60	1.87	1.60	1.40	1.00	0.857	0.75
70	2.18	1.87	1.64	1.17	1.000	0.875
80	2.49	2.14	1.87	1.33	1.143	1.000
90	2.80	2.40	2.10	1.50	1.286	1.125
100	3.12	2.67	2.34	1.67	1.429	1.25

*Costs are in dollars per 1,000,000 B.t.u. of useful heat as produced in the building for efficiencies indicated.

[a]Assumed average calorific value, 535 B.t.u. per cu. ft.

[b]Assumed average calorific value, 1000 B.t.u. per cu. ft.

and manufactured gas is sold on the therm, or 100,000 B.t.u. basis. In Chicago, the first two therms cost 29 cents per therm, the next 24 cost 15.8 cents per therm and the remaining gas consumption for house-heating is 7 cents per therm per month. This 7-cents therm rate is equivalent to natural gas at $0.70 per thousand and consequently this natural gas curve may be used for making comparisons with other fuels, after the first 26 therms, costing $4.37, are consumed. Similarly, for other cities the rate must be studied and correction made for such base charges.

Special Cases

In a few instances the heating efficiencies and calorific values used in the comparisons in this article may not apply. If the actual values are known, the costs per 1,000,000 B.t.u. of useful heating may be readily calculated by means of the procedure outlined.

Airplane Air Conditioning Equipment

THE American Air Lines has recently placed into operation a number of air conditioning units for preconditioning passenger planes before flights. These units are entirely self-contained and are mounted on high-speed truck chassis, which can be driven to any point accessible to an ordinary truck.

The unit operates without external connections and has sufficient capacity to establish a 70F temperature in a 21-passenger plane cabin in about 10 min. elapsed time in winter or summer. An immediate shift from heating to cooling operation may be made.

A 15-kw. gas engine generator set is used to provide the power to drive the refrigeration machine and an electric generator. The gas engine generator set is used to make the unit completely independent of any outside source of power.

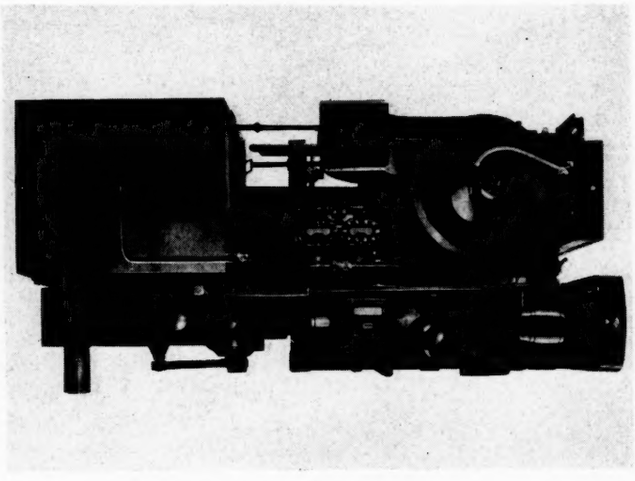
When used for summer cooling outside air is taken into the side of the truck through a grille and passed over a removable air filter, through the lower portion of the air conditioning unit, over the evaporator coils, through a silencer chamber, and into the centrifugal blower. Air from the blower is discharged into an air silencer and through a special adjustable elbow located in the side of the truck body and then delivered through the 5-in. hose to the plane.

The refrigeration system consists of a 3½ in. bore by 4 in. stroke, four-cylinder, Freon refrigeration compressor discharging gas into an evaporative condenser. A pressure cutout switch is connected to the compressor to shut off the gas engine in case of excessive discharge pressure on the system or too low suction pressure.

A large water tank located above the air conditioning unit provides water to the evaporative condenser.

When used for winter heating, the two valves on the pipes from the gasoline engine to the water heating coil are opened and the thermostatic valve in the radiator line is turned to winter position, which causes the engine to run at a higher water jacket temperature. The water heating coils act as a preheater for the fresh air taken in from the outside. Four aluminum grid type electric heaters of 5-kw. capacity each are used to provide additional heat for the air when necessary. These heaters can be thrown in to the circuit one at a time. Each heater is provided with an overload protection device, which will cut out the supply of current in the event that current is supplied to the heaters while the fan is not in operation.

An interesting feature which makes the air conditioner valuable in an emergency is the fact that it is in itself an auxiliary power plant, and in case of need can be used around a hangar for supplying power to the radio station or keeping the electric current and lights on.



Top view of apparatus installed in truck body for air conditioning airplanes. The unit has sufficient capacity to establish a 70F temperature in a 21-passenger plane cabin in about 10 min. elapsed time in winter or summer.

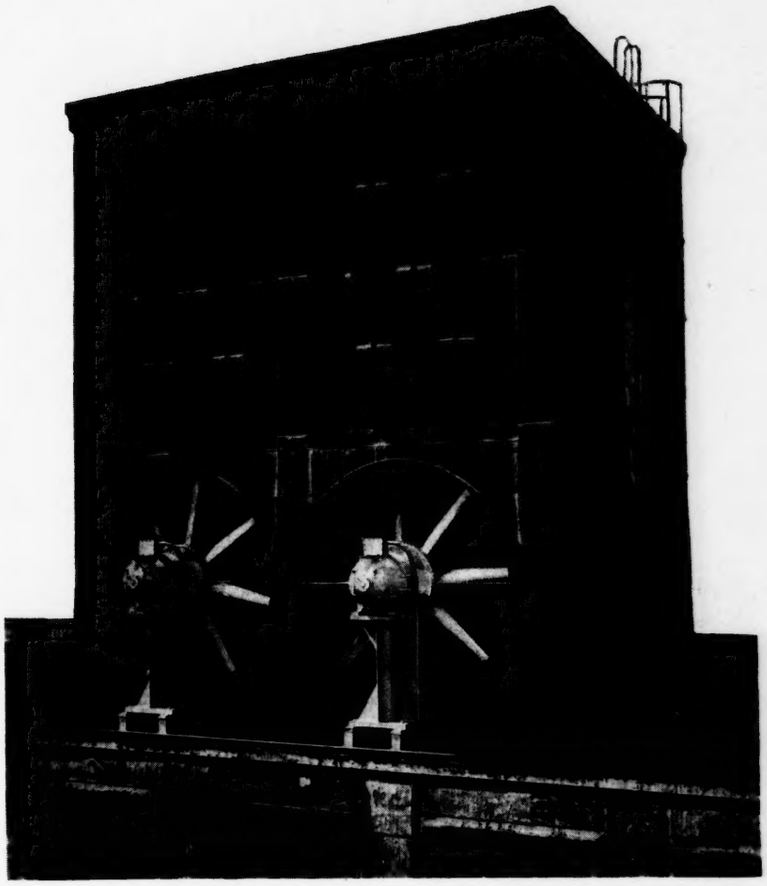


Fig. 1. Two cell forced draft cooling tower.

Mechanical Cooling Equipment for Condenser Water

By FRED D. MOSHER

THE majority of large air conditioning plants with capacities of 250 tons or over are installed in buildings located in the metropolitan sections of big cities. To cool recirculated condenser water for such installations it is usually necessary to use mechanical draft cooling towers since space is not available for such devices as spray pond, atmospheric and natural draft cooling towers, or spray towers.

A mechanical draft cooling tower will cool from two to five times as much water as will the naturally ventilated tower with the same ground area. However, its initial and operating costs are higher due to the cost of the fan and motor. As in the case of the other types of towers the temperature to which the water can be cooled depends on the wet bulb temperature of the surrounding atmosphere. A modern mechanical draft tower can be expected to cool the circulated water to within 4 to 8F of the air wet bulb temperature.

The selection of equipment for cooling condenser water for large air conditioning systems in buildings located in cities is a problem which calls for careful thought and experience. In this article the author discusses the types of equipment which can be used with large systems where the space available is limited. Among the subjects covered are types of towers, including forced draft, induced draft, and indoor towers; also cost analysis of a water cooling installation and maintenance needed for such equipment.

Mechanical towers can be divided into the forced draft and induced draft types. The forced draft tower is usually a box-shaped structure with an alloy steel or wood shell enclosing a "fill" of triangular-shaped wood members although it may be filled with a water spray from nozzles. In the fill type the warm water to be cooled is brought in at the top of the tower and trickles down over the wood filling to a collection pan at the bottom. The air is forced in at the bottom of the tower by a motor-driven fan so as to give a counter flow of air through the falling water. It is this counter flow of air together with the high

velocity of the air which makes possible the small ground area per unit of heat dissipating capacity.

These towers may be built in single units or in groups of two or more, depending on load requirements. The fans and motors of a tower of this type are easily accessible for inspection and repair while in operation and in group units one may even be shut down completely while the others are kept in operation. The fans are of the axial flow propeller type and in some types the speeds may be varied with the atmospheric conditions to control, to a great extent, the temperature of the outgoing water. Since the usual velocity of the air in the tower is about 700 f.p.m. special spray eliminators must be used to prevent excessive loss of water. Spray loss should not be over 5% of the total circulation.

Induced Draft Tower

The induced draft type cooling tower is of the same general construction as the forced draft type but with the fan and drive located at the top of the tower and with the bottom louvered on all four sides to allow air to enter. The cooling conditions in this type tower are the same as those obtained in the forced draft tower including air velocities and temperatures obtained. It is sometimes claimed, however, that better circulation is effected by the induced draft and that this results in higher efficiency. On the other hand, the maintenance costs are said to be higher than this type of tower which would tend to offset any savings made on lower power costs. An elevation sketch of this type tower is shown in Fig. 2.

Indoor Tower

An outgrowth of cooling tower development is the indoor cooling tower. This type is essentially a mechanical draft cooling tower designed for operation inside a building. With a few exceptions it has found its widest application in the smaller installations. Combined with condensers to form a unit they are becoming quite popular for all sizes of installations.

The indoor cooling tower draws its air from the surrounding area and discharges it through a duct to the outside or roof of the building. When sprays are used the indoor tower becomes similar to ordinary air washer. Since the space in which these towers are installed is usually restricted as to height, the air is nearly always made to flow horizontally through the tower. These towers can be of the wood, metal or spray filled type. In any of the designs the air velocity must of necessity be high to do the required amount of cooling, since the counterflow principle of the outdoor tower is lacking.

An indoor cooling tower 40 sq. ft. in area and 10 ft. high will cool 75 g.p.m. to within 6F of the wet bulb temperature with a water loss of about 2% of the circulation.

The design of cooling towers and their installation is the work of specialists thoroughly familiar with all the factors involved. Since each installation and location are individual problems no definite rules can be laid down. Towers are designed to cool a definite amount

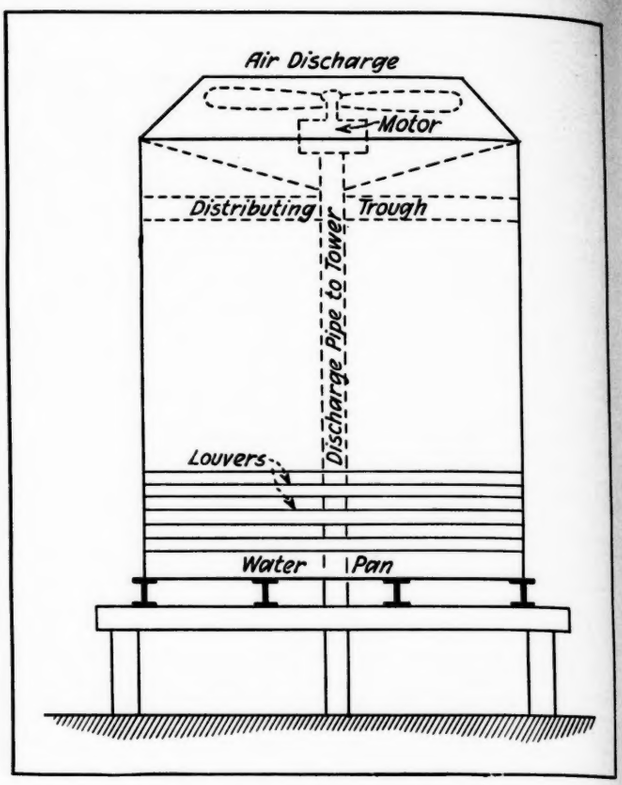


Fig. 2. Induced draft cooling tower.

of water per unit of time through a definite temperature range with specified dry bulb and wet bulb temperatures of the atmosphere. With mechanical draft towers the fan speeds are also specified. A guarantee may also be made concerning the amount of makeup water required and the power used by the auxiliary pumps and tower fan motors. When tests are being made in the field, atmospheric conditions are not under control of the operator and are rarely the same as those specified in the guarantee. It is desirable, then, to have an understanding with the builder concerning the deviation from design conditions and its effect upon the performance of the tower.

Cost Analysis

Whenever the purchase of air conditioning equipment, which will require a large amount of condenser cooling water, is under consideration, the first step to be taken is that of cost analysis. When cooling towers are to be used as a means of cooling the recirculated water, the matter of costs is very important. The factors of cost involved in the economical operation of cooling towers are many and worthy of considerable attention. For such an investment as cooling towers require, it is essential that the investor get the maximum obtainable service for his money.

The factors to be considered in the operation of mechanical draft towers are: (1) interest on investment; (2) depreciation; (3) cost of power for fan motors; (4) cost of power for pump motors; (5) maintenance; (6) cost of makeup water.

The figures resulting from such an estimate should be compared with the cost of purchased water. For comparison purposes consideration should be given to

TABLE 1.—COMPARISON OF COOLING WATER COSTS USING COOLING TOWERS

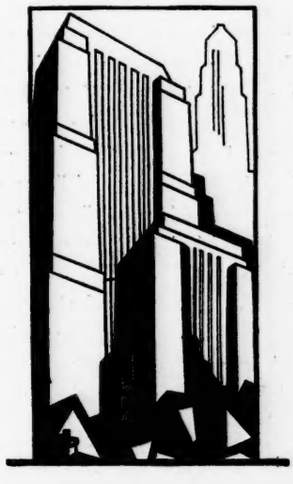
Total cost of water purchased	$12,000 Yearly
Interest on investment ($60,000)	3,600 "
Sinking fund for depreciation	2,400 "
Maintenance	1,200 "
Power for fans	600 "
Power for pumps	450 "
Makeup water (purchased)	350 "
Total cost of tower water	$8,600 "
Saving on diesel cooling water	2,200 "
Difference	$6,400 "
Savings effected by installing towers	$5,600 "

the possibility of using the water obtained from the towers for other equipment such as steam turbine condensers or diesel engine jackets. It may also be possible to use the towers to supply water for these other machines during cold periods when the air conditioning machines are not operating.

A typical cost analysis of a cooling tower installation used in connection with a 600-ton air conditioning plant is shown in Table 1. In this case the water is circulated from the refrigerant condensers to the condensers of turbines which drive the compressors. During cold weather and periods when the air conditioning equipment is out of service, the water is used for cooling two diesel electric generator units.

Some of the items shown may be reduced somewhat. The cost of makeup may be very low where the water used for this purpose is pumped from a well. In many cases the item of maintenance may be lower than shown in the above table, when, for instance, the care is routine. It should be noted that the purchase of water from a municipal system for cooling purposes does not require the purchase of equipment of any kind. There is, however, a minimum amount of apparatus which must be used for a tower system, regardless of capacity. This should be taken into consideration when considering towers as a means of obtaining cooling water for an air conditioning system of small tonnage. It should be noted that insurance on equipment, being a matter of choice, has been omitted on the cost analysis.

Curves may be plotted to show graphically the advantages or disadvantages in dollars and cents of using towers for a given installation. The items already discussed are considered in addition to the number of hours of operation. The total yearly costs are then compared with the yearly cost of purchased water. The same method can be applied to any other type of cooling equipment. Curves of this kind are shown in Fig. 3. The load being known it is easy to determine whether or not equipment for cooling recirculated water should be installed; they also indicate whether the cooling apparatus under consideration could be used profitably for other types of equipment, such as generating units, during the hours the air conditioning system is idle.



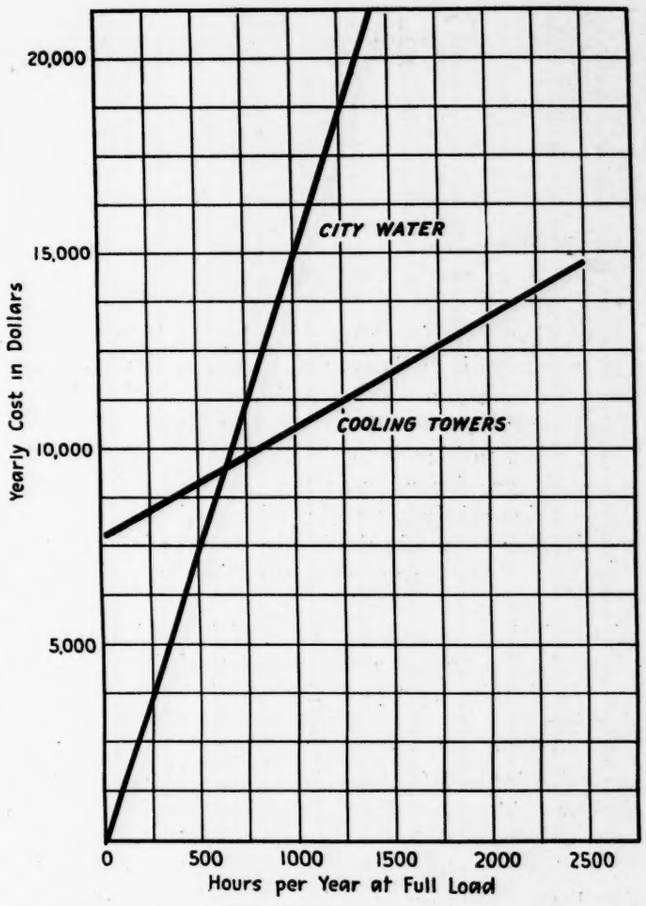


Fig. 3. An analysis chart to compare the costs of city water and cooling tower water.

Good maintenance routine is required on any cooling tower installation. Periodic cleaning is necessary for efficient operation. Motors and fans must be inspected regularly. Impurities such as sulphur gases are drawn into a cooling tower with the air. These impurities form destructive acids in the tower which corrode piping, condensers, and pumps, and eventually destroy them. It is necessary, therefore, that careful analysis of the water be made periodically and the proper chemical treatment given it to prevent corrosion of the circulating system.

The object of the engineer in solving his cooling water problem is to use the most economical cooling equipment to adequately supply his needs. It has been the purpose of this discussion to acquaint the reader with the various methods used for obtaining cooling water for air conditioning. When location restricts the user to a few of the methods mentioned, the method that comes out on top in the acid test of cost analysis is the one to be used.

Steam Compressor Used in German District Heating Plant

AN interesting district heating installation is that at Braunschweig, Germany, supplied by steam from two turbines, each of 4200-kw. capacity, and one of 10,000-kw. capacity, all supplied with bleeder steam. No provision is made for the regulation of the pressure of the extraction steam; and the extraction for the 4200-kw. turbines is from the first stage and for the 10,000-kw. turbine from the fourth stage. The extraction pressure depends to a large extent on the load on the turbine existing at any particular time. As long as the initial pressure in the heating system is lower than the extraction pressure at the turbines, the amount of steam can be controlled by means of throttle regulation of the extraction valve. This initial pressure depends, however, on the amount of heat required by the heating system and the existing demand for heating.

On a winter day the peaks of the output produced and the demand for heat do not coincide; the former, at an outside temperature of —5F, attains its maximum value at 9 a.m., when the morning peak of steam consumption has already begun to fall off. On the other hand, the steam consumption of the heating plant has already decreased materially by the time the evening lighting peak load comes on, with the result that from 6 p.m. on, the high extraction pressure available cannot be utilized. If the pressure desired for the heating plant is not available or just barely available at the bleeder connection of the turbine, extraction becomes impossible and the heating plant has to be run on throttled live steam.

Where extraction is controlled, the steam passing the low pressure part of the turbine is so throttled that the desired pressure at the point of extraction is available. However, this is accompanied by material throttling losses in the steam flowing through the low pressure part to the condenser, and when the extraction is slight the efficiency of the turbine is adversely affected. With uncontrolled extraction the efficiency of the low pressure part of the turbine is not affected.

Extraction of the full amount of heating steam from the 10,000-kw. turbine can be done only after 6 p.m. The rest of the time the extraction steam would be supplied by throttling live steam and from exhaust steam of the auxiliary turbine driving the condenser machinery. Thus in 1933 only 65% of the demand for heating steam, which amounted to 6513 tons, could be supplied from extraction. To this had to be added 21,485 tons of live steam. In many cases only a slight increase in pressure would have been sufficient to make it possible to feed it into the heating system.

The turbo-steam compressor plant designed to solve these difficulties has a compression ratio of 1.2 to 1.6, initial pressure of 29 to 59 lb. per sq. in. absolute, and a final pressure of 36 to 78 lb. per sq. in. absolute; the machine runs at controlled speeds of from 8000 to 12,000 r.p.m.

The steam compression machinery during the period when heating is required operates from 6 a.m. to 4 p.m. The final compression pressure is controlled electrically by varying the speed of the driving turbine. The steam compressor is driven by a constant pressure turbine running on roller bearings. The turbine is supplied with main and safety governors working through oil pressure. It is designed to the following specifications: Initial steam pressure, 220 lb. per sq. in. absolute; inlet steam pressure, 627F; back pressure up to 78 lb. per sq. in. absolute; speed about 12,500 r.p.m.; output at the couplings 260 kw. The centrifugal compressor, direct driven by the turbine, is supplied with steam from one side and has three stages. The shaft of the compressor runs in roller bearings. The compressor was designed for the following normal operating conditions: steam received, 10 tons per hr.; admission pressure, 38 lb. per sq. in. absolute; temperature of the steam admitted, 410F; final compression pressure, 48 lb. per sq. in. absolute; temperature of the compressed steam, about 500F; steam consumption of the driving turbine, 5.6 tons per hr.

The economy of the steam compressor is materially affected by the fact that it works practically without losses, since the energy employed there, with the exception of very slight radiation losses, is recovered as useful heat in the compressed steam and as exhaust steam from the driving turbine.

Assuming that even after the compression unit has been installed 6000 tons of throttled live steam must be expended in heating and that 5000 tons of live steam are needed to drive the turbines, 10,000 tons more than before of steam per year can be taken for heating purposes from the turbines by means of extraction. If it be assumed that average steam consumption of the 10,000-kw. turbine in the high pressure part is 290 lb. per kw-hr., approximately 770,000 kw-hr. can be generated per year from this extraction steam. Assuming an expenditure of 4 lb. of brown coal per kw-hr., the use of extraction steam would produce a yearly saving of 1540 tons. From this, however, must be subtracted the heat value of the work contained in the 770,000 kw-hr., after it has been converted into terms of coal.

There are no material maintenance costs involved. The extraction of 10 tons of steam per hour corresponds, with a steam consumption of 290 lb. per kw-hr., to an output of 770 kw-hr. from the high pressure part of the turbine. The installation of a turbine compressor produces the same economic results as would the installation of a back pressure turbine of the same output, but the former arrangement has the advantage that the operating main turbine does not lose a part of its useful load through the back pressure action.

ENGINEERING NOTEBOOK

Unit Heater Standardization

The engineering committee of the Industrial Unit Heater Association after a year's study of field conditions and after conferences with the Bureau of Standards, Washington, presented its report on the "Standardization of Unit Heaters of the Propeller Type" at the association meeting held in Cleveland July 15, 1937. The report outlined two proposals: (a) the elimination of unnecessary sizes of units and (b) the publishing of more precise data covering performance. It was the opinion of the committee that the attainment of these objectives would greatly benefit the buying public, the engineer, and the heating contractor. The members adopted the following broad program with the understanding that further study on standardization would be continued.

Recommendation No. 1—Sizes of Units

No Manufacturer to Make or List More Than 25 Sizes Between the Limits of 15,000 to 350,000 B.t.u.

A unit size is defined as a combination of a *certain* heating element with a *certain* propeller type fan and a *certain* speed motor, said combination to be rated at its maximum 60 cycle operating speed. Rating to be at 2 lb. steam pressure and 60° entering air, in accordance with the code for testing and rating unit heaters. The maximum final temperature of the air leaving the unit at the above basic rating is not to exceed 135°.

When this same combination of heating element and fan is equipped with a lower speed motor, it is not considered a new size. When the same combination of heating element and fan is supplied with a decorative, or so called Deluxe, casing or a peculiarly shaped casing in such a manner so as not to effect the basic rating, it is not considered a new size.

When the heating elements, or fan, or both are changed so as to alter the basic rating then it is considered a net size unit.

Recommendation No. 2—Warranted Operating Pressure and Temperature

Price Sheets and/or Rating Tables of Each Manufacturer to State Prominently the Guaranteed Steam Working Pressure and Temperature.

Recommendation No. 3—Ratings in Accordance with Standard Test Code

Manufacturers Shall Consult the Standard Test Code and Include in Their Ratings Such Values as are Specifically Called for in the Code.

Recommendation No. 4—Outlet Velocity

Rating Tables of Each Manufacturer State Outlet Velocity Measured at Final Temperature of air in Accordance with the Following Formula:

$$V = \frac{C.F.M.}{A}$$

V = Velocity in feet per minute

CFM = Cubic feet of air per minute, measured at final air temperature

A = Net area of outlet opening in square feet, less 7½% to compensate for obstruction due to outlet louvers.

Recommendation No. 5—Effective Date

Entire Program to Become Effective Not Later Than June 1, 1938.

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Smoke Abatement Engineer's Terminology

An excellent compilation of the terminology of the smoke abatement engineer was given by David R. Mitchell, Assistant Professor of Mining and Metallurgical Engineering, in a paper entitled "Smoke, Dust and Air Pollution," presented at the Short Course in Coal Utilization held recently at the University of Illinois. The various terms and their definitions are listed below:

MICRON, a unit of linear measurement, that is .001 mm. (10^{-3} mm.) or approximately 1/25000 of an inch.

STAUBOSPHERE is the name given to that system comprising the dust contained in the atmosphere—in it but not of it—an immense solid particle system, coexistent and probably coextensive with the earth's atmosphere.

AEROSOL is the term applied to small solid particles suspended in air.

DUST is small visible and invisible particles that are settled out of air streams with difficulty. From the very nature of dust particles they have been formed from the disintegration of larger particles, which disintegration continues during their life. Individual particles can be seen by the unaided eye down to about 50 microns, while 0.2 microns is the lower limit of microscopic visibility.

SMOKE is a term used in a large sense to include all the products of combustion—smoke proper, dust and gases. In a strictly scientific sense it should be limited to growing particle systems. Smoke starts as atoms or large molecules (.005 microns approximately) that rapidly increase in size and agglomerate until dispersed in air when they begin to disintegrate and become dusts. A smoke system is thus a growing one; a dust system is a disintegrating one. Smokes may be considered a species of dusts.

SOOT is usually considered to be composed mainly of carbon particles. Most soot deposits contain varying amounts of inorganic particles as well.

SOOT-FALL is used by engineers and scientists to describe the dropping out of solid particles from the atmosphere as determined by tests, and includes both carbon and inorganic particles of solid matter. Results are usually expressed in tons per square mile per month or per year.

SMOG is a term used to describe a combination of smoky and foggy atmosphere.

ABSTRACTS of Current Papers, Books and Pamphlets

Tests of Stoker Coals

There are five characteristics in coals which can be expected to govern the performance of the stoker—volatile matter content, ash content, ash composition and fusion temperature, caking and coking tendencies, and size. Of these five perhaps the one which can be varied more easily by the coal producers is the size. Because of this and also because the size has a considerable effect on stoker performance the Bituminous Coal Research, Inc., has been conducting a program of research to study the effect of size on combustion. This is the second part of the report on this study, the first part having dealt with the relationship between the size of coal placed in the hopper and that in the retort. This section reports on the effect of the size of coal on the combustion performance.

Although tests on only four coals have been included in this report, the coals are representative of the American coals whose ash softening temperatures are 2200 to 2400F, so that some general conclusions can be drawn. It was found that the uniformity and dependability of operation of the stoker was materially affected by size only with the strongly caking coal. More data are required on such coals to establish the limits of caking and coking tendencies where removal of fines should be practiced. The greatest effect of the size of coal on the operation was the change in the rate of feed due to the difference in bulk densities of the various sizes. To maintain uniform combustion efficiency the rate of air supply must be changed as the rate of coal feed is changed. As a consequence, although one size of coal may perform as well as another when the stoker is properly adjusted, it is important that, after the adjustments are made, the size be kept as uniform as possible.

Due to the fact that copies of the first part of the report are out of print the principal results are summarized in an appendix to this report.

[*"The Relation of the Size of Bituminous Coals to their Performance on Small Underfeed Stokers—Part II. Burning Tests on Four Typical Coals," by Ralph A. Sherman, E. R. Kaiser, and H. L. Limbacher. Includes a resume of Report No. 1, Part I. Published by Bituminous Coal Research, Inc., 803 Southern Building, Washington, D. C. Paper cover, 6 x 9 in., 59 pages, price, 50c.*]

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Axial-Flow Fans

Recently a comprehensive investigation of axial-flow fans, designed according to the airfoil theory, was conducted by Curt Keller in the laboratories of the Escher Wyss Co., of Zurich. The results were published in German.

This book makes available the results of the investigation to English speaking engineers. The book was translated by Lionel S. Marks who has done much work in this country on the design of fans according to the airfoil theory. It should be noted that the book is not a direct translation but a part translation and a part abstract. The translator presents the book in this form because he felt that such a treatment would result in a book of greater efficiency to the designer.

The book deals with the complete axial-flow fan unit consisting of inlet, guide vanes, fan wheel and diffuser. In chapters I and II, elementary airfoil theory is used to establish the relations between pressures, volumes, and efficiencies. Chapter III considers the mutual interference of the airfoil grid.

A classification of axial-flow fans on the basis of a dimensionless characteristic number (analogous to the specific speeds of hydraulic turbines and centrifugal pumps) is presented and is utilized in establishing the general design of the fan. A series of tables and graphs facilitates this operation.

The principal contribution of this book is contained in chapter IV, which gives the performance data of a series of axial-flow fans having from 4 to 20 blades. In these fans both the guide vanes and runner blades were adjustable for angular setting. For each wheel, the fan characteristics were determined for a considerable range of settings of both the guide vanes and the runner blades and the best operating conditions of the fan were thereby established. Extensive tables and graphs make these results fully available to the designer.

The test results show that single-stage axial-flow fans can be calculated with accuracy by means of the elementary theory presented in the text.

[*"Axial-Flow Fans," by Curt Keller and translated by Lionel S. Marks. Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York. Cloth bound; 6 x 9 in.; 140 pages; price, $4.*]

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Thermodynamics

A study of the subject of thermodynamics is essential to all engineers because it gives a foundation for such practical subjects as air conditioning, heating, and refrigeration. This text is written primarily for engineering students and assumes a knowledge of calculus. The first part of the book is devoted to the explanation of the kinetic theory of heat and also to the few fundamental concepts vital to thermodynamic thinking. After this is a discussion of the perfect gases and a consideration of actual engineering devices which use gases. Vapors are considered a narrow portion of the gaseous phase and thus, together with their practical applications, logically follow gases. Subjects covered by other chapters include the flow of fluids; flow of vapors; engineering devices using vapors; mixtures of gases and vapors, refrigeration; and general thermodynamic relations.

[*"Thermodynamics," by H. A. Everett, published by D. Van Nostrand Co., Inc., 250 Fourth Ave., New York. Cloth bound, 6 x 9 in., 430 pages. price, $3.75*]

Health Protection of Welders

The extension of the processes of welding, cutting, burning, and coating of metals by means of a gas flame or by the electric arc has been rapid through the entire field of industry wherever metal construction and machine manufacture and repair are involved.

This book presents a rather complete compilation of present-day information on health hazards connected with welding operations. It discusses the types of welding and lists four principal hazards that are encountered: (1) electric shock and burns; (2) radiant energy (roughly classified as ultra-violet rays, infra-red rays and visible light rays of excessive intensity); (3) gases, fumes, and dust; (4) miscellaneous, which includes such hazards as the possible exhaustion of oxygen in the air breathed due to pollution by products of combustion in confined, unventilated spaces. These various hazards are discussed in some detail in the booklet and protective measures are outlined. Methods of treatment are also considered.

[*"Health Protection of Welders," published by the Policyholders Service Bureau, Metropolitan Life Insurance Co., 1 Madison Ave., New York. Paper cover; 5¼ x 8 in.; 27 pages; available on request.*]

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BRIEF REVIEWS

SMOKE REGULATION. The object of these rules and regulations is to insure construction of new plants and buildings and changes in existing plants being done in such a manner that smoke will not be made. The rules are intended to be a guide to architects, engineers, contractors, equipment manufacturers and building and plant owners. They incorporate the requirements of the Department of Smoke Regulation covering the issuance of permits and certificates for all construction, reconstruction, alteration and repair work involving any fuel burning apparatus. [*"Rules and Regulations Governing Details of Fuel Burning Equipment Required for Issuance of Permits and Certificates, May 1937." Department of Smoke Regulation, Board of Health and Vital Statistics of Hudson County, Court House, Jersey City, N. J. Paper cover; 19 pages; 3¾ x 6¾ in.; price, 6c. in stamps.*]

STOKERS. A study of the use of Iowa coal in domestic stokers. In the experiments a domestic stoker and boiler were set up in the laboratory and various Iowa and out-of-state coals were tested. The discussion includes the following: a comparison of the cost of heating with Iowa and out-of-state coal; the probable fuel savings to be attributed to a stoker; suggestions for burning Iowa coals in the most satisfactory manner; and the amount of attention required with a stoker. Results of tests with different Iowa coals are given in tabular form. [*"The Use of Iowa Coal in Domestic Stokers," by M. P. Cleghorn and Roy Helfinstine. Bulletin 134 of the Iowa Engineering Experiment Station, Iowa State College, Ames, Iowa. Free.*]

SILICOSIS. The thesis of this paper is that certain minerals have a protective influence in an environment which is otherwise conducive to silicosis. Three substances are selected as suitable protectors—carbon black, iron oxide (hematite), and alkaline earth carbonates. The investigators believe that these substances are able, first, to render silica dust more easily eliminated by the lung, and, second, to protect the lung from the effect of colloidal silica liberated by proximate minerals which the lung has not been able to eliminate. The idea advocated by these investigators is to add to a noxious siliceous dust, one or more of these protector minerals in the form of a dust, for an effective and economical means of rendering the noxious dust harmless. [*"A Mineralogic Study of Silicosis," by R. C. Emmons and Ray Wilcox; American Mineralogist; Vol. 22, No. 4, April 1937; pages 256 to 267.*]

ARC WELDING. A second edition of this well known arc welding manual and operator's training course. The book has been completely revised and brought up to date and a special effort has been made to present the facts in a non-technical manner so that it will be as useful to the beginner as to the experienced operator or technician. Subjects covered include the welding arc; welding equipment; weldability of metals; types of joints and welds; strength of welds; speed and cost of welding; using the metallic arc; welding with bare electrodes; and welding with coated electrodes. [*"The New Arc Welding Manual and Operator's Training Course," by W. J. Chaffee. Published by The Hobart Brothers Co., Box EW-46, Troy, Ohio. Artificial leather cover; 94 pages; 5½ x 8 in.; price, $1.00; special price to "Heating & Ventilating" readers, 50c.*]

ROBINSON-PATMAN ACT. A discussion of the method of securing evidence for complaints under the Robinson-Patman Act. [*"Method of Securing Evidence for Complaints Under the Robinson-Patman Act," published by the National Association of Master Plumbers, Edmonds Bldg., 917 Fifteenth St., N.W., Washington.*]

THERMOCOUPLES. A study of the characteristics of the common types of thermocouples to determine what happens under certain conditions of treatment. The results obtained seem to indicate that for the temperature range, for the size of wires, and for the conditions under which the tests were made: (1) Heat treatment of copper-copel, copper-constantan, and chromel-alumel thermocouples above about 200C causes them to indicate temperatures which are different from those before heat treatment, the discrepancy, in general, being greater the higher the temperature of heat treatment; moreover, measurements of lower temperatures show, in general, less discrepancy than measurements of higher temperatures. (2) Heat treatment of copper-copel and copper-constantan thermocouples at temperatures between about 200C and 300-350C causes them to indicate a higher temperature than before such heat treatment; heat treatment above 300-350C causes them to indicate a lower temperature. It may be concluded that copper-copel and copper-constantan thermocouples possess a rather high degree of reliability if used in the temperature range 0 to 200C. [*"Reliability of Common Types of Thermocouples," by D. Quiggle, C. O. Tongberg, and M. R. Fenske. Published by Industrial and Engineering Chemistry, Washington, D. C. Volume 29, No. 7, July 19, 1937, pages 827 to 830.*]

WHAT READERS SAY • • •

Heat Loss Coefficients

How do you figure the U for a ceiling of lath and plaster with a 5-in. concrete floor above and with a 4-in. air space between? The ceiling is hung from the I-beams running through the concrete floor.

What temperature do you use for figuring heat loss in an unheated attic?

Also, how do you figure the heat loss through a wall where the earth is piled up against the wall on the outside?—*P. C. J., Chicago*

Refer to HEATING & VENTILATING's Reference Data Sheet Nos. 69 and 70 where the formula for U is given as

$$U = \frac{1}{\frac{1}{f_i} + \frac{1}{f_o} + \frac{x}{k} + \frac{x}{k_1} + \frac{1}{a_1} + \frac{1}{a_2} + etc.}$$

Where

f_i = inner surface conductance = 1.6
f_o = outer surface conductance = 6.0
x = thickness of solid material, inches
k = heat conductivity of solid, B.t.u. per hr. per sq. ft. per in. thickness per °F.
a = heat transmitted across air space within construction, B.t.u. per sq. ft. per hr. per °F. = 1.1
U = heat flow through wall, B.t.u. per hr. per sq. ft. per °F.

Each construction necessitates some modification of the formula in order to accommodate it. The modification consists of adding any symbols necessary or dropping any which do not apply. The manner in which the above formula is set up makes it apply to a construction with an inner and outer surface (f_i and f_o), two solid materials (k and k_1) with thickness of x inches, and two air spaces (a_1 and a_2). If the wall contained only one air space the term $1/a_2$ would be dropped out. If it had three materials in it another term (x/k_3) would have to be added.

In your example, since the both surfaces are on the inside of the building the F_i and F_o are identical—1.6. The k for concrete is given on the data sheet as 12.0; that for lath and plaster, 2.0, and the resistance of an air space over 1½ in. as 1.1, so that substituting in the formula we have

$$U = \frac{1}{\frac{1}{1.6} + \frac{1}{1.6} + \frac{5}{12} + \frac{1}{2.0} + \frac{1}{1.1}} = 0.315$$

The temperature of an unheated attic is often assumed as being half way between the temperature of the adjoining heated space and the design temperature on the outside. If the design temperature is –10F and the space below is heated to 70F, then the temperature of the attic could be assumed as 30F.

Another method is to estimate the temperature of unheated rooms as 35F above the outside temperature.

A common assumption for ground temperatures is to assume the ground temperature to be 40F above the outside design temperature. If the design temperature is –10, we would assume the ground temperature to be 30F. To determine the heat loss multiply the U of the wall by the number of square feet of that wall and by the temperature difference, which in the case mentioned would be (70-30) or 40F.

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Oil Burners

I have read carefully the article published in the April issue of your journal, page 53, by Arthur H. Senner, and I am much concerned to note the conclusions arrived at therein.

In this article, higher efficiencies are invariably shown for vertical rotary-type equipment than for gun-type equipment under every condition except that of the boiler-burner unit.

Many years ago Mr. Senner made some very careful investigations and tests and reached altogether different conclusions, but apparently he was shown the "light," and now adopts different methods for testing that produce a different result in the over-all efficiency.

In this connection, I would like to point out that Mr. Senner, in using the boiler as a Junker calorimeter, gives the spinner-type burner an unfair advantage, and I have no doubt that this, in a very large measure, accounts for the difference in efficiencies as shown in his article.

I have been testing and watching tests on different types of equipment for the past twenty years, and my experience is definitely contrary—when considered under operation conditions of test—to the conditions given in Mr. Senner's article. I think it would be very interesting if you were to get an expression of opinion from some unbiased engineers, who are competent to express it . . . —*Lionel L. Jacobs, vice-president, Electrol Inc., Clifton, N. J.*

. . . The test method which we have used and reported on in the article under discussion is a more accurate and generally more satisfactory scheme than the other, more commonly used set-ups. As a matter of fact we have tried all conceivable schemes and found the so-called Junker calorimeter method to be by far the most satisfactory.

I cannot imagine just what inconsistencies Mr. Jacobs refers to between the present test results and those published several years ago. However, if he will bring these specifically to my attention I would be glad to attempt to clarify the matter; also I would be interested in seeing any of Mr. Jacobs' test data which show a different relative performance of the pressure-type and rotary-type of burners.

In reading the letter of Mr. Jacobs I find that his criticisms have not been specific enough to permit me to prepare a very satisfactory reply, however, I will be glad to hear from you further in this connection and assure you that I will make every attempt to answer Mr. Jacobs' questions satisfactorily and completely.—*Arthur H. Senner, Bureau of Agricultural Engineering, U. S. Dept. of Agriculture, Baltimore, Md.*

NEWS OF THE MONTH

240 Manufacturers to Exhibit at H. & V. Show

NEW YORK — Increased volume of new building activities plus the tendency to recondition existing structures is reflected in the advance support being accorded the Fifth International Heating and Ventilating Exposition, which will be held at Grand Central Palace here January 24-28, 1938.

Winter heating and air conditioning are now related in interest to every phase of life and industry. The presentation of latest developments in the two fields will draw to the Exposition a world-wide attendance. Three floors of Grand Central Palace have been reserved and most of the available floor space has been engaged by more than 240 manufacturers.

Boston A.C. Bureau Holds All-Day Meeting

BOSTON—The fourth annual outing of the Air Conditioning Bureau of Boston took the form of an all-day session at the New Ocean House, Swampscott, September 24. The full program of the day started off with golf at 9:30 in the morning, continued through luncheon and sports in the afternoon, and closed with a banquet and band concert in the evening.

The evening banquet with an attendance of nearly four hundred climaxed the program since winners of various efforts throughout the day's outing were announced and prizes said to have a total retail value of $2200 were distributed.

Julius Daniels, president of the Bureau, presided at the banquet, introducing guests of the Association present and acting as master of ceremonies in the distribution of prizes.

Outings of the Air Conditioning Bureau here have drawn increasingly large attendance each year since they started and each year larger quarters have been necessary in order to furnish sufficient accommodations.

Inspect Gimbels A.C.

PHILADELPHIA—An inspection trip to look over the new air conditioning installation in Gimbel Brothers store in Philadelphia, held on the evening of September 15, drew a crowd of over four hundred. The inspection tour of the plant followed a dinner sponsored by the Electrical Association of Philadelphia, and to which had been invited members of the ASHVE, ASRE, AIA, Chestnut Street Business Men's Association, and Market Street Business Men's Association.

Speakers included A. C. Kauffman, vice-president, Gimbel Bros.; George E. Whitwell, sales vice-president, Philadelphia Electric Co.; Ellis Gimbel, well-known member of the Gimbel firm.

The installation in the Gimbel store was designed by Charles A. Leopold, prominent Philadelphia consultant engineer.

Rideout Talks on Weather

BOSTON—E. B. Rideout, nationally known meteorologist and weather forecaster, was the guest speaker at the first fall meeting of the Air Conditioning Bureau of Boston. Mr. Rideout gave a short illustrated talk on "Problems of Weather Forecasting" and on weather across the United States, with the formation of storms and the cycles and excess temperatures of the past few years. This was followed by a booster meeting of members in the interests of the annual outing September 24.

Drinker Predicts Room Size Iron Lungs

BOSTON—Room-size iron lungs are predicted by Prof. Philip Drinker, of the Harvard School of Public Health, who, with Louis A. Shaw, eight years ago invented the present type of iron lung.

The room would be easier on the infantile paralysis patient than lying tied to one spot by the narrow, 5 ft. 6 in. long metal barrel, the iron lung of today, which encloses the body up to the neck.

More important than the idea of comfort, this room-size respirator would allow the physician to enter the same chamber. His patient's body would not be largely shut off from his ministrations. He would have a better opportunity for treatment, and for the possibility of making faster progress in learning how to combat the effects of the breathing paralysis.

Professor Drinker has built one such room, at the Children's Hospital here, to hold four patients. Doctors and nurses enter it through a double door. They notice no sensation out of the ordinary except a slight pressure in the ears, as the air of the whole room alternately becomes a partial vacuum and then returns to ordinary air pressure.

Rooms can be made for at least eight patients, Professor Drinker says. He thinks rooms will be cheaper in the end than separate iron lungs. The latter at present cost nearly $1000 each.

Chicago A. C. Installations

CHICAGO—Commonwealth Edison Company reports that 51 air conditioning installations were added to its lines during August. Of these 23 were central systems totaling 338 tons and 28 were room coolers totaling 25¼ tons.

St. Louis Smoke Survey Report Completed

ST. LOUIS — WPA workers recently completed a survey of St. Louis records to show the number and classification of buildings equipped with heating appliances. This information has been assembled for the guidance of city officials to enforce a smoke ordinance just passed.

Actual enforcement of the new ordinance awaits the appointment of a smoke commissioner by city authorities. So that data collected will be ready for his use, they are being turned over to the director of public safety whose department will have general supervision in enforcing the new ordinance.

The survey shows a total of 134,029 buildings in the city equipped with some type of heating appliance. They are classified as follows: single-family dwellings, 59,320; two-family residences, 28,168; commercial buildings, 20,339; multiple dwellings, 18,902; light industrial plants, 4,175; institutions, 929; heavy industrial plants, 872; garages, 741; city park buildings, 265; other city property, 221.

Institute Adds to Staff

CHICAGO — Utilities Engineering Institute has augmented its staff by the addition of W. H. Hoehne, formerly Pacific Coast manager for the McCall Corp.; Walter W. Voss, engineer, formerly with Minneapolis-Honeywell Regulator Co., and P. B. Ford, formerly with the Welsbach Co. and Greer College.

Mr. Hoehne fills the post of vice-president in charge of sales, while Mr. Voss augments the instruction staff of the Institute. Mr. Ford has been for the past five years chief refrigeration instructor at Greer College.

COAL COMMITTEE MEETS

Members of the Technical Advisory Committee of Bituminous Coal Research, Inc., at Battelle Memorial Institute, Columbus, where they met recently at one of their conferences to consider the progress of the research program being carried on in their fuel laboratories. Left to right, C. A. Reed, secretary, Bituminous Coal Research; E. R. Kaiser, Battelle Memorial Institute; J. B. Morrow, Pittsburgh Coal Co.; J. E. Tobey, Appalachian Coals Inc.; John Fielding, Jr., Hanna Coal Co.; C. E. Williams, director, Battelle Memorial Institute, R. A. Sherman, J. M. Pilcher, and R. C. Cross, Battelle Memorial Institute.

Non-Union and Union Wage Rates Paid in Building Trades Studied by Bureau of Labor Statistics

WASHINGTON—While information has been available from numerous sources on union wage rates for various groups of workers, there have been few comprehensive studies of the wages paid to non-union workers. Such a study has, however, been recently completed by the Bureau of Labor Statistics, under the direction of Herman B. Byer, chief of division of Construction and Public Employment, Department of Labor. The study has been described by an article entitled "Wage Rates and Hours of Labor in the Building Trades," by E. P. Sanford.

The study shows the union, non-union, and weighted average rates paid for 21 groups of building trade workers together with similar information covering helpers. The accompanying tables show these data for steamfitters and sheet metal workers and their helpers for the United States as a whole and broken down by geographical regions.

In assemblying these data the records of over 6000 contractors were examined and scheduled with 5450 included in compiling the reports. From these reports the wages paid to and the hours worked by over 186,000 employes were recorded. This probably represents between 25 and 30% of the total of building trade workers employed in the United States during 1936.

There are wide variations among the different occupational groups in the wages paid in addition to the variations between union and non-union workers; further, there is a wide variation by geographical location.

Of the workers covered by the survey 58% were employed on private building construction projects and 42% on public building. The average wage rate paid to all employes working on private projects was 90.4c per hr., and on public projects 93.8c per hr. In 39 of the cities studied the average wage rate was higher on private projects than on public construction and in 63 cities the rates for public projects were higher. The highest average rate, the survey shows, is paid in the Middle Atlantic region and the lowest in the East South Central region.

In the East South Central, Mountain and Pacific regions, bricklayers receive the highest average rate, while in New England top rank is held by metal lathers, in the Middle Atlantic states by hoisting engineers, in the East North Central and South Atlantic regions by structural iron workers, and in the West North Central and West South Central regions by steamfitters.

For the country as a whole, 0.2% of all employes received less than 25c per hr.; 12.2% received from 25c to 50c; 22.2% received 50c to 75c; 18.7% received 75c to $1; 20.6% received $1 to $1.25; 16.9% received $1.25 to $1.50; 9.1% received $1.50 to $1.75; and 0.3% received over $1.75 per hr.

The overall average hourly rate paid to building trades workers, 91.8c, is among the highest paid in industry, but it should be noted that nearly 50% of the employes covered by this survey received less than the average rate, and that there were thousands of employes in the industry (common laborers and building laborers in the semi-skilled class) who received rates ranging from 15c to 75c per hr.

Slightly more than two-thirds of all the employes covered in the survey were reported by the contractors to be union workers. The union strongholds, however, are in the North. In the Middle Atlantic region, for example, 82.3% of the workers covered were union members.

As in most other trades and industries, wage rates in building construction tend to vary with the size of the city, rates being highest in the large metropolitan areas.

In a general way the rates for both union and non-union workers conformed with the general trend, but union rates in the smaller cities held more closely to the average rate paid in the larger cities than did the non-union rates. In cities with a population of from 50,000 to 100,000, for example, the average rate for non-union workers was 28.2% below the average in cities with a population of over 1,000,000, but union rates in these cities were within 18.6% of average for larger cities.

The rates of negro workers in the building trades were substantially below those of white workers of the same skills in all parts of the country. The greatest difference occurred in the rates of skilled workers. Compared with an average of $1.156 per hr. for skilled white workers, skilled colored workers averaged only 79.1c. Semi-skilled colored employes received an average of 13.9c per hr. less than white workers of the same class, and unskilled colored workers averaged 14.1c per hr. less than unskilled white workers. Wage differentials between white and colored workers were found in all geographic divisions.

In round numbers, 59,000 workers, or slightly less than a third of all employes scheduled in this study, were engaged in residential building. Of this number, 56.7% were union members and 43.3% were non-union men. In non-residential construction 72.2% were union and 27.8% were non-union employes.

The working time of 70.7% of the workers for whom information was obtained was 40 hr. per week, 9.3% worked 30 hr. a week, and 1.6% over 30 and under 40 hr.; 10.4% worked 44 hr.; 4.9% worked 48 hr., and only 2.6% worked over 48 hr. per week.

In building construction, as in most other industries, there is a well-defined trend toward a shorter working week. This trend is especially noticeable in the West Coast cities. In Seattle, for example, the 6-hr. day and 30-hr. week has been standard for a year previous to this survey.

HOURLY WAGE RATES OF STEAMFITTERS, 1936

SECTION	TOTAL	UNION	NON-UNION
STEAMFITTERS			
United States	$1.260	$1.302	$0.950
New England	1.201	1.291	0.902
Middle Atlantic	1.311	1.324	1.083
E. North Central	1.317	1.329	0.997
W. North Central	1.295	1.309	1.004
S. Atlantic	1.120	1.260	0.898
E. South Central	1.144	1.165	0.921
W. South Central	1.190	1.195	1.125
Mountain	1.205	1.228	0.967
Pacific	1.262	1.296	1.065
STEAMFITTERS HELPERS			
United States	0.723	0.786	0.548
New England	0.678	0.754	0.540
Middle Atlantic	0.831	0.872	0.550
E. North Central	0.669	0.693	0.636
W. North Central	0.721	0.778	0.533
S. Atlantic	0.614	0.685	0.455
E. South Central	0.550	0.521	0.571
W. South Central	0.573	0.642	0.430
Mountain	0.628	0.708	0.514
Pacific	0.693	0.716	0.651

HOURLY WAGE RATES OF SHEET METAL WORKERS, 1936

SECTION	TOTAL	UNION	NON-UNION
SHEET METAL WORKERS			
United States	$1.079	$1.202	$0.819
New England	1.140	1.245	0.803
Middle Atlantic	1.259	1.295	1.011
E. North Central	1.057	1.192	0.823
W. North Central	1.055	1.201	0.851
S. Atlantic	0.997	1.245	0.772
E. South Central	0.907	0.936	0.772
W. South Central	1.095	1.245	0.828
Mountain	0.965	1.142	0.711
Pacific	0.995	1.102	0.799
SHEET METAL WORKER HELPERS			
United States	$0.511	$0.607	$0.457
New England	0.522	0.687	0.462
Middle Atlantic	0.553	0.618	0.446
E. North Central	0.560	0.668	0.504
W. North Central	0.511	0.578	0.476
S. Atlantic	0.430	0.594	0.404
E. South Central	0.437	0.444	0.431
W. South Central	0.425	0.460	0.419
Mountain	0.520	0.633	0.426
Pacific	0.552	0.606	0.500

J-M Stiffens Credit Terms

NEW YORK — A warning against unsound and loose credit policies was voiced by Lewis H. Brown, president, Johns-Manville Corp., in announcing that the maximum term allowable under the J-M Credit Corporation's deferred payment plan for building materials had been reduced from 36 months to 24 months.

The 24-month term is a restoration of the maximum allowed under the original JM deferred payment plan, instituted six years ago, Mr. Brown said. This was changed in 1933 to conform to the more liberal modernization credit provisions of the National Housing Act, which now are no longer in operation.

Although he warned against unsound credit policies, Mr. Brown emphasized that he believes the financing of installment sales of durable goods to be "not only economically sound, but one of the most constructive tools that business can employ."

"The dangers of deferred payment selling do not lie in the system itself. It is the excesses and abuses of the system which have been harmful. Even in the crash of 1929 when installment sales for the year had reached a total of approximately six billion dollars, consumers were able to pay off their time payment obligations, which, for the most part, had been incurred on a sound basis.

"Within the past few years, however, deferred payment terms generally have been lengthened, credit standards lowered, down payments in many cases eliminated, and installment selling extended to so-called 'soft' merchandise and even to such intangibles as personal services.

Federation Announces Fall Courses

NEW YORK—The Federation of Architects, Engineers, Chemists and Technicians has announced an expanded schedule of courses for its Federation Technical School. This school, a non-profit co-operative institution sponsored by the Federation for technical men and women, was started in January, 1936, for the benefit of members of the Federation and others preparing for New York State licensing examinations. The number of students expanded until last spring when the school had 300 enrolled.

Included in the courses offered in the evening are one on mechanical equipment of buildings, a heating, ventilating, and air conditioning course in two parts; one on piping design and layout, and another on plumbing. Each consists of two sessions per week.

Moderate fees are charged. Further information can be obtained from the Federation Technical School, 116 E. 16 St., New York.

A.C. for Walgreen's Miami Store

MIAMI—Air conditioning equipment costing approximately ten times that installed in the average Walgreen store will operate in that company's million dollar drug store here which opened October 1.

The air conditioning unit cost about $50,000 and has a capacity of 100 tons. The equipment will be in operation the year round. As in other stores, a 12F difference between outside and inside temperature will be maintained when the outside temperature is 95F. When the outside temperature is less, the range between the two will be diminished, and when it is above that figure, the range will be increased.

District Steam for Ontario City

OWEN SOUND, ONT.—The Public Utilities Commission is having plans drawn for a central heating system to serve the business places on 2nd Avenue east from the Hydro plant north of 10th Street, on both sides of the street. Charges will be made according to the total radiator surface in each property and the steam as metered.

Suggestions on Installation of A.C. Systems

NEW YORK—A number of instances have arisen recently where through failure to comply with important provisions for fire protection, installers of air conditioning equipment have found it necessary to take down and replace certain portions, or make changes in systems after they have been completed, in order to avoid penalties in the fire insurance rate. Such difficulties could be avoided by having the plans for air conditioning equipments checked over by the local fire insurance inspection organization before installation has been started. The inspection organizations give this service without charge.

The installation of air conditioning equipment in buildings protected with automatic sprinklers frequently involves some interference with the effective operation of sprinklers, making necessary the installation of additional sprinkler heads or rearrangement of sprinkler lines. For these reasons it is particularly important that the inspection organizations be consulted on the installation of air conditioning equipment in sprinklered buildings.

The regulations of the National Board of Fire Underwriters for the installation of air conditioning systems cover the features of installation that relate to fire hazard and include such provisions as construction of ducts, their arrangement and support, automatic fire doors and dampers, air filters, fan controls, and refrigerant coils in air ducts. Copies of these regulations are obtainable from the National Board of Fire Underwriters, 85 John St., New York, N. Y.; 222 W. Adams St., Chicago, Ill., or Merchants Exchange Building, San Francisco, Calif. Copies may also be obtained from the offices of local insurance inspection organizations. This code was also printed in full in HEATING & VENTILATING for July, 1937.

31 Ice Cooling Jobs Added by American

NEW YORK — The restaurant and theater field constitutes a primary market for installation of ice cooling systems, according to C. F. Holske, manager of the air conditioning department of the American Ice Company which has recently completed 15 new air conditioning installations.

This company operates in New York, Washington, Baltimore, and Boston, and in those cities installed 31 ice cooling systems so far this year. Of the 15 most recent installations nine are in restaurants, bars, night clubs and grilles, and five in theaters.

Canadian Boiler Prices

TORONTO, ONT.—Study of boiler and radiator prices over a term of 17 years reveals the fact that the price of these commodities has dropped 53% in that time. In 1920, a No. 4 round cast-iron heating boiler sold in Toronto to the trade for $277.20. Today's price is $131.75. Ten years ago the price of the same boiler was $143.22, and 11 years ago, $147.84.

Cast-iron radiators have also been reduced as drastically. In 1920, the price to the trade was $66 per 100 sq. ft. for 38 in.; today, $35.70. The low point was early in 1929, when it was $31.

Housing Symposium and Exhibit Scheduled

NEW YORK—"The Hygiene of Housing" will be the topic of a symposium presented here October 8 by the committee on the hygiene of housing of the American Public Health Association. This committee, with Dr. C.-E. A. Winslow of the Yale School of Public Health as chairman, has as its object a formulation of minimum standards of planning and construction for low cost housing with a view to making possible healthful homes, at the lowest possible cost.

Papers to be presented at the symposium by members of the committee include: Housing and Health—R. H. Britten, U. S. Public Health Service; Construction Methods—R. L. Davison, J. B. Pierce Foundation; Sanitary Engineering—H. A. Whitaker, Minnesota State Department of Health; Town Planning —Prof. James Ford, Harvard University; Safety in the Home—M. G. Lloyd, U. S. Bureau of Standards; Lighting—James E. Ives, formerly of U. S. Public Health Service; Air Conditioning—Professor Winslow.

Discussion of these papers will be led by health officers from various sections of the United States, among whom will be Doctor Ruhland and Doctor Vaughn. Doctor Parran, Surgeon General of the United States, will open the meeting.

The symposium will be held at 9.30 a.m. in the North Ballroom of the New Yorker Hotel. All those with a professional interest in housing are invited to attend. A housing exhibition, prepared by the staff of the committee to demonstrate the historical development of housing and the relation of housing to health, will be on display October 5-8 in the ballroom of the Hotel Pennsylvania.

Radial Compressor for U.P.R.R. Job

OMAHA — Installation of equipment which will provide air conditioning for the 12-story Union Pacific Railroad Company's headquarters building here has been started by Airtemp. The new installation will be one of the largest of its kind in the middlewest. It will have a capacity of 825 tons and will provide air conditioning for 3,600,000 cu. ft. of building space housing approximately 2000 employes.

This will be the first major installation in the middlewest for the recently announced Airtemp radial compressor.

Mass. Oil and Gas Consumption Up

BOSTON—An increased consumption of oil, soft coal, and gas as fuels for home-heating is shown in the annual survey of the Office of the Division on the Necessaries of Life, Department of Labor and Industries, Massachusetts. Figures for the heating season of 1935-36 and 1936-37 are given below.

The largest loss in tonnage was in domestic sizes of anthracite, deliveries of which dropped 126,000 tons from those in the previous year. However, this drop was partly due to the mild winter.

The Department reports an increase of 600 gas-fired heating installations in Massachusetts as compared with the previous year. The number of central heating plants in the season 1935-36 was 6827 while in 1936-37 this figure had increased to 7427.

FUEL	1935-36	1936-37
Anthracite, tons	2,609,000	2,483,000
Anthracite (buckwheat), tons	195,000	178,000
Coke, tons	1,081,000	1,027,000
Bituminous coal, tons	950,000	1,100,000
Briquets, tons	66,000	56,000
Other manufactured fuel	10,000	5,000
Oil, gal.	650,000,000	750,000,000
Gas (estimated), cu. ft.	3,103,192,000	3,301,593,000

Milwaukee Has 1300 Automatically Heated Homes

MILWAUKEE — Thirty and two-tenths per cent of the homes having automatic heating systems in this city use stokers, an increase of practically 400 units over last year, according to a consumer analysis made by the "Milwaukee Journal."

It was found that 89.6%, or 168,581, of all greater Milwaukee families were heating their own homes as of January 15, 1937. On the same date in 1936 the percentage of such families was 88.7 and the number was 165,634. Of the families heating their own homes this year, 5.4% or 9,103, reported that they had an automatic heating system as compared to 4.7%, or 7,785 families last year. This would indicate that more than 1,300 automatic heating systems of one type or another have been installed in greater Milwaukee homes during the past year.

An analysis of automatic heating systems in use follows:

DIVISION OF FAMILIES BY HOME HEAT

YEAR	PER CENT	NUMBER
Heat their own homes—		
1937	89.6	168,581
1936	88.7	165,634
Do not heat their own homes—		
1937	10.4	19,567
1936	11.3	21,101

AUTOMATIC HEATING SYSTEMS BY TYPES

CLASS AND YEAR	PER CENT	NUMBER
Oilburners—		
1937	62.9	5,726
1936	64.1	4,990
Stokers—		
1937	30.2	2,749
1936	30.2	2,351

FAMILIES HEATING OWN HOMES

CLASS	PER CENT	NUMBER
Have Automatic Heat—		
1937	5.4	9,103
1936	4.7	7,785
Do not have Automatic Heat—		
1937	94.6	159,478
1936	95.3	157,849

Soft Coal Industry to Start Advertising

CHICAGO — The first national advertising campaign sponsored by the bituminous coal industry will make its appearance in September publications, J. P. Williams, Jr., president of the National Coal Association, announced recently.

This campaign will first appear in architectural and building papers. Its primary purpose will be to acquaint architects, contractors and builders with the new service for them which the National Coal Association, nationwide organization of bituminous coal operators, has devised. This service will provide architects and builders with detailed drawings of typical plans for basements designed for modern bituminous coal and coke heating. Included in the drawings will be not only designs for modern enclosed coal bins of concrete, wood, plywood, and hollow tile, but also working details of their construction.

University Lab Installs Refrigeration

UNIVERSITY, ALA. — A refrigeration test plant was recently installed at the University of Alabama for use by the engineering department. The equipment was installed by Smith & Berry, Birmingham refrigerating engineers. The plant is fully equipped for experimental use by students.

Sound Motion Picture Presents Visualization of Heat

NEW YORK—The first official showing of "Heat and Its Control," a sound motion picture produced by Johns-Manville, was attended by 150 representatives of the industrial and technical press here. This talkie makes available for the first time an actual visualization of what heat is, and the story of its use and methods of conservation.

Actual laboratory demonstrations, animated drawings and shadowgraphs are used in the picture to help visualize the nature of heat and to illustrate heat transfer by radiation, convection and conduction. Molecular activity, the passage of heat through a boiler wall, and how insulating materials resist the passage of heat likewise are illustrated by animated drawings.

Other animated drawings and laboratory demonstrations are used to explain the phenomenon of thermal conductivity and the reasons for the vast difference in the conductivity of various substances. Radiant heat energy is also visualized in the same effective manner.

An interesting series of shadowgraphs enables one to actually see the air currents set up by heat in so-called dead air spaces as well as to see the convection currents set up by flames, heated pipes, and the like.

Man's first efforts toward the scientific conservation of heat, the activity in a modern heat research laboratory, how new materials for conserving heat are developed, how they are manufactured, and methods of utilizing these materials are pictured in detail.

In photographing the latter, a replica of the kitchen where Watt worked, as well as a full-sized model of his first steam engine were constructed. Many other historical "sets" were also built for "Heat and Its Control."

Alabama Contractors Organize

BIRMINGHAM, ALA. — As a move to help stabilize plumbing and heating practice in this city and environs, the Plumbing, Heating and Piping Contractors Association of Jefferson County has been organized and incorporated by a group of union shops. A working agreement has been made with the journeymen's union, also on methods of computing bids.

Officers are: R. C. Staley, Staley Plumbing & Heating Co., president; J. H. Hickman, vice-president; Guy Acton, secretary-treasurer. Other incorporators are J. M. Brown, W. A. Finley, Joseph W. Pate, G. A. Crook, Herman G. Hudson, John L. Crim, John Tully, R. Brinskelle and Elmer Moffett. The association is not affiliated with any national association.

Boston A.C. Jobs Total 165 Hp. in August

BOSTON—Air conditioning installations for August reported in Boston Edison territory, total 165 hp. This includes 10 room coolers of 7½ hp. and 100 hp. previously unreported, on a re-rating

The installations indicate a trend toward air conditioning among the smaller stores and businesses and toward residential air conditioning, whereas the large stores are still holding back, though some of them needed air conditioning desperately this past summer.

Chemists to Discuss A.C.

PHILADELPHIA, PA.—The Chemical Engineering Symposium Committee of the Division of Industrial and Engineering Chemistry of the American Chemical Society, is actively engaged in plans for the fourth Chemical Engineering Symposium, on Drying and Air Conditioning. The meeting is to be held here at the University of Pennsylvania on December 27 and 28, 1937. Covering theoretical foundations and industrial applications, a number of interesting papers have been promised from industrial and educational sources.

Describes Montana Mine Cooling Project

WASHINGTON—"Air conditioning, or air cooling, for the ventilation of the Butte Mines is distinguished from most other air cooling methods mainly by the fact that the cooling effect is derived directly from the compressor or other artificial refrigeration machinery," A. S. Richardson, ventilation engineer, Anaconda Copper Mining Co., Butte, Mont., told delegates attending the annual metal mining convention and exposition of the Western Division of the American Mining Congress, held here in September.

"The average annual temperature in the district," he said, "is approximately 40F, with exceptionally low humidity during the summer months, so that unlimited natural cooling power is available at a useable temperature range. A satisfactory solution of the ventilation problem required only a means of making this natural cooling power of the surface atmosphere effective in the working zones of the mines."

Speaking of the system in use at the Butte Mines today, he said: "The present underground plant was designed to cool the mine air from 80F wet bulb to 65F wet bulb, under average summer conditions. It has been effective in cooling a volume of air ranging from 55,000 to 65,000 c.f.m. through a wet bulb temperature range varying from 13 to 23F at different times of the year. For air conditioning the whole mine it is planned to cool from 250,000 to 300,000 c.f.m. through a 15F wet bulb temperature range. The cooling effect will be approximately 800 to 1000 tons. For this it will be necessary to circulate 800 to 1000 g.p.m. of water, and the main pipe lines that have been installed are large enough for that purpose."

Merchandising School for Coal Dealers Started

PRIMOS, PA.—A two-weeks' school in the merchandising of anthracite and anthracite-burning equipment conducted by Anthracite Industries, Inc. at its laboratory here has proved so successful that it has been decided to follow it with a regular series of such schools, the next of which will be conducted from October 4-15.

The basic purpose of the school is to provide practical information on basic heating principles, anthracite burning equipment, and sales and merchandising methods.

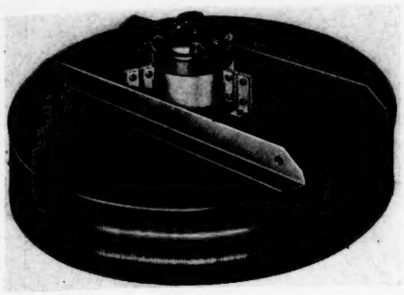
Enrollments for the school are being accepted from any coal dealer's organization purchasing anthracite from a contributing producing company, from contributing producing companies, from manufacturers of equipment approved by the laboratory, and from equipment dealers and heating contractors handling the sale and installation of approved equipment. Registrations are limited to 125.

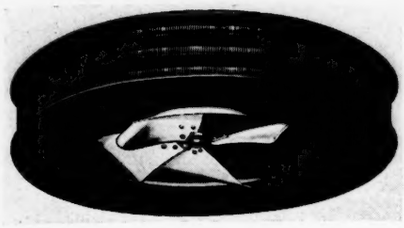
Ralph Baker Hayward

LOCKPORT, N. Y.—Ralph Baker Hayward, 63, president of The R. B. Hayward Co., Chicago, one of the largest ventilating and air conditioning contracting firms and sheet metal product manufacturers in the middle west, died August 24 following a short illness while visiting relatives here.

The R. B. Hayward Co., founded in 1909, installed the ventilating and air conditioning systems in the Merchandise Mart, Stevens Hotel, Palmer House, Field Building, Marshall Field & Co., La Salle Hotel, Wrigley Building, and many other large buildings. Mr. Hayward was the originator and pioneer manufacturer of steel cable and wire reels, some of which were used in the construction of the New Oakland Bridge in California. He was a member of the ASHVE, University Club, Western Trades Golf Association, and other organizations.

NEW EQUIPMENT





Trane Projection Type Unit Heater

NAME—Trane projection type unit heater.

PURPOSE—For all space heating applications, such as factories, sales rooms, garages, offices, laboratories, etc.

FEATURES—In large spaces, especially those with considerable height, there is difficulty in preventing excessive temperature at ceiling when room temperatures at breathing zone are at desired level. This can be overcome with high velocity emission of heated air but this has previously not been accomplished as it is difficult to diffuse the air stream and carry it considerable distance at the same time. This unit is said to accomplish these purposes in a way not hitherto attempted.

The unit consists of upper and lower plates which are installed in a horizontal plane; the upper plate being solid, the lower with a large orifice which acts as a fan outlet. Between the peripheries of the two plates is a two-row circular heating coil. The ambient air is drawn through the coil at a low velocity and then projected straight downward to the floor by the four-blade propeller fan. After leaving the fan outlet, the air stream diverges so that when it reaches the floor there are no noticeable drafts and as it moves downward it induces a volume of air which results in a gradual temperature drop. The motor is mounted on a three-point resilient construction to prevent motor noises being transmitted to other metal parts. It also keeps motor out of the air stream. Motors are provided with ball bearings and have lubrication which need not be serviced during heating season.

LITERATURE AVAILABLE—Bulletin 284

MADE BY—*The Trane Co., 2005 Cameron Ave., La Crosse, Wis.*

Sterling Vacuum Pumps

NAME AND MODEL NUMBER—Sterling type S, series 200, 300, and 400 return line vacuum heating pumps.

PURPOSE—For removing air and condensate from heating system.

FEATURES—This pump is of the water ejector vacuum producer type. Pressure developed in the discharge line of the pump forces water through the ejectors at high velocity, causing air to be drawn into the ejector from the chamber surrounding the jets. The vacuum thus produced lifts air and water from the accumulator chamber of the pump receiver. The vacuum producer consists of a cast iron casing into which a number of bronze jets mounted in a bronze plate are assembled. These jets are located slightly in front of a similar number of bronze tubes of the venturi type also mounted on a bronze plate. The vacuum pump has only one moving part outside of the motor, the rotor of the pump itself. The cast iron receiver is divided into two compartments by a partition. The lower receiver acts as an accumulator for the air and water from the returns of the heating system. The upper receiver is a separating chamber where the air is liberated to the atmosphere and the water is held in storage to be again circulated through the vacuum pump and producer.

TYPES AVAILABLE—Simplex and duplex design with and without separate accumulator tanks. All sizes of units up to and including 40,000 sq. ft. of steam radiator surface have accumulator tank built into the pump receiver. Sizes of 40,000 sq. ft. and larger are built with separate accumulator tanks. Separate accumulator tanks are only required with standard designs of pumps up to and including 40,000 sq. ft. when the return line is lower than the inlet to receiver.

MADE BY—*Sterling Engineering Co., Milwaukee, Wis.*

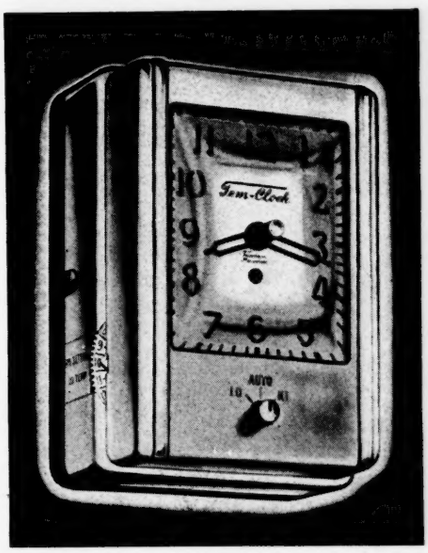
Penn Temperature Clock

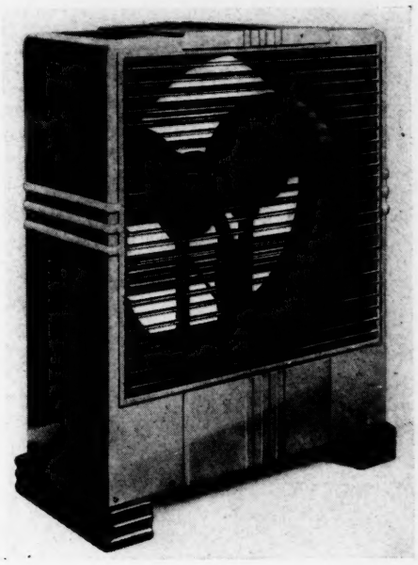
NAME AND MODEL NUMBERS — Tem-Clock, types 772 and 774.

PURPOSE — For automatic clock control of lowered night temperature. For use in connection with the Penn Temtrol.

FEATURES—Type 772 Tem-Clock is for service on all types of heating plants controlled by Temtrol (Penn heat anticipating room thermostat). It provides three control positions which the owner may easily set by means of a selector knob. These settings are (1) an automatic control whereby the clock operates a switching mechanism to automatically lower temperature at night and restore it in the morning; (2) continuous day level temperature; (3) continuous night level temperature. Time settings may be changed at any time. Type 774 for stoker installations performs the day-night functions of the standard 772 Tem-Clock and in addition operates a time interval, hold fire switching mechanism which can be set from 1 to 15 minute firing periods every 30, 60, or 90 minutes. This eliminates the need for a synchronous electric motor to operate a hold fire switching mechanism in the basement.

MADE BY—*Penn Electric Switch Co., Goshen, Indiana.*





Burnham Fan Cooler

NAME—Burnham fan cooler.

PURPOSE—For supplying outside air to offices, hotels, restaurants and residences.

FEATURES—Fan is available as either a portable unit or a complete unit for attic cooling of residences. The attic cooling package includes a vent box with flame-proof trap door, ropes, pulleys and automatic fan switch. The vent box is made of panels of special sound-absorbing acoustical board set in slotted wooden frame. When the fan is not running the shutter closes the grille opening. The trap door is linked with the switch to start and stop fan. Fan starts when the trap door is opened and stops when it is closed. Illustration shows the portable floor model cooler.

SIZES AND CAPACITIES—Made in three sizes, 30 in., 7,000 c.f.m.; 39 in., 10,000 c.f.m.; and 45 in., 14,000 c.f.m.

MADE BY—*Burnham Boiler Corporation, Irvington, N. Y.*

Arco Air Conditioner

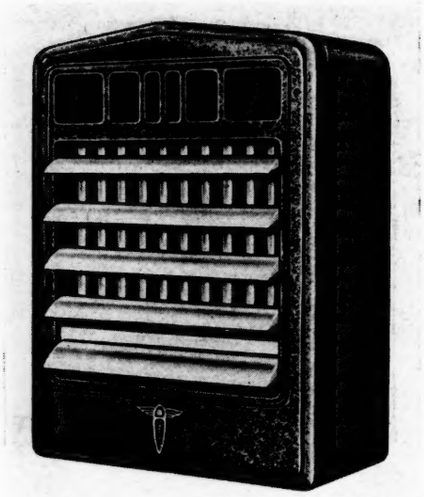
NAME AND MODEL NUMBER—Arco air conditioner series RH.

PURPOSE—For year-round air conditioning.

FEATURES—This conditioner is furnished for two general classes of applications, one for winter air conditioning and two, for conditioning during the summer season. For installations involving summer cooling and dehumidification, units are equipped with coils for either direct expanded refrigerants or chilled water service. The conditioner is assembled on a heavy steel base which serves also as a drip pan. Sides, top, and ends of the casing are formed of furniture steel. All units are equipped with a slow speed quiet operating fan with the bearings on the outside of the casing. Motors are also mounted outside the casing. Coils for either heating or cooling are of the finned tube type. The humidifier is of the self-cleaning impingement type. All units are equipped with filters which can be removed.

SIZES AND CAPACITIES—Four sizes with normal capacities ranging from 875 to 3500 c.f.m. and total heat output, using steam at 2-lb. pressure, from 75,500 to 256,000 B.t.u. per hr. Cooling capacities range from 21,000 to 65,000 B.t.u. per hr. using direct expanded Freon at 40F suction temperature.

MADE BY—*American Radiator Co., 40 West 40th St., New York.*



Surface Combustion Unit Heaters

NAME—Janitrol gas-fired unit heaters.

PURPOSE—For space heating using gas.

FEATURES—A new quiet style fan has been adopted so that objectionable operating noises will be eliminated. Many design and construction features have also been modified to reduce the noise. Styled to meet the modern trend with an offset front panel with rounded corners. Casing finish is blue crackle baked enamel with air louvers of aluminum.

SIZES AND CAPACITIES—Eleven sizes ranging from 25,000 to 200,000 B.t.u. per hr.

MADE BY—*Surface Combustion Corp., Toledo, Ohio.*

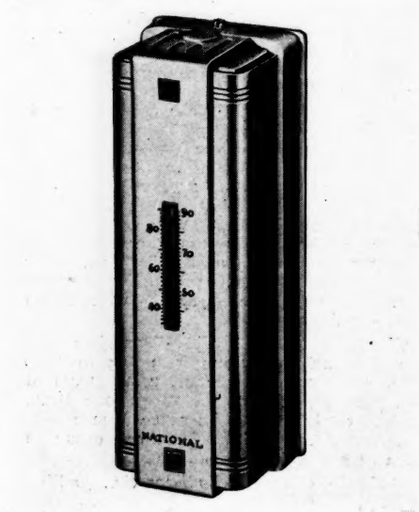
M-H Thermostats

NAME—National Helmet Sealed thermostat.

PURPOSE—Pneumatic thermostat for recording room temperatures.

FEATURES—The outside appearance of the line of pneumatic thermostats have been changed by using a modern case designed along the lines of the other M-H thermostats. All moving parts operate in a sealed chamber to prevent foreign substances from interfering with the operation of the control. National's thermostatic element of ebonite has been retained. The overall size of the instrument has been reduced and the thermometer has been recessed for protection. The temperature range of the new thermostat is from 46 to 90F.

MADE BY—*Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.*



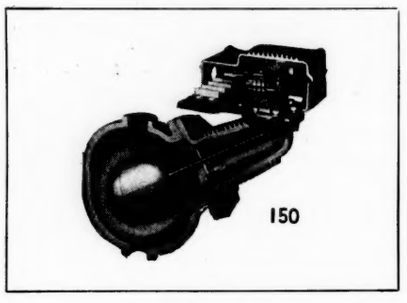
McDonnell & Miller Boiler Control

NAME AND MODEL NUMBER—McDonnell No. 150 combination pump control and low water cutoff.

PURPOSE—To start and stop an electrically-driven boiler feed pump in accordance with the requirements of the boiler and to shut off the oil burner or stoker in case of a fuse failure in the pump circuit.

FEATURES—This unit is a combination pump control and a low water cutoff. These two controls have distinctly separate operating levels and the differential between the two circuits is adjustable. Also, the differential between the "off" and "on" operation of the controls is adjustable. A flexible metallic bellows is used to transmit the float power to the outside switch mechanism so as to eliminate the use of stuffing boxes. When the boiler water reaches a predetermined level the pump control circuit starts up the boiler feed pump. At a lower level the second circuit shuts off the oil burner or stoker. The unit is designed for use with steam pressures up to 150 lb.

MADE BY—*McDonnell & Miller, Chicago.*



Goodrich Steam Hose

NAME—Burst-proof steam hose.

PURPOSE—For carrying steam up to 200 lb. working pressure.

FEATURES—The manufacturer states that when hose fails it will leak but nothing can cause it to burst except an external blow severe enough to cut the wire reinforcement. Hose is designed with a reinforcement of high tensile steel wire. Wire is applied in a braided form with openings large enough to permit the rubber to rivet itself, thus preventing any possibility of tube collapse. The hose is made up of seven layers of various materials. These materials in order from inside to outside are: inner tube of heat-resisting rubber, layer of steel wire, heat-resisting rubber, steel wire, heat-resisting rubber, asbestos cord, and a black rubber cover.

SIZES AVAILABLE—3/18 to 2½ in.

MADE BY—*The B. F. Goodrich Co., Akron, Ohio.*

Horn Weatherstripping

NAME—Hornex rope.

PURPOSE—For weatherstripping casement or metal windows.

FEATURES—Hornex rope is made by mixing 1 part of Hornex paste and 1½ parts Hornex filler. This mixture is then pressed in an ordinary caulking gun and a long string or rope is extruded on to a dry dusty surface. The rope is allowed to dry for about 2 or 3 hours and is then ready for use. It is applied to the stationary member of a casement or pivot type window. Manufacturer states that Hornex is a very strong adhesive when tested against a direct pull. It is also said that this material will not dry up in the can or bottle and does not require heating before use. Can also be used for expansion joints in floors, walls, and roofs.

MADE BY—*A. C. Horn Co., Long Island City, N. Y.*

Dunham Steam Valves

NAME—Dunham Orifiex valve.

PURPOSE—A radiator valve with an adjustable orifice.

FEATURES—This valve provides a means of changing the size of the orifice without disconnecting it from the radiator. A calibrated guide surrounds the stem. Adjustments are provided for in increments of 1 sq. ft. A removal of the button from the top of the handle makes the adjustment stem accessible. The valve need only be turned on or off since it is the orifice within the valve and not the position of the handle which controls the steam flow.

MADE BY—*C. A. Dunham Co., 450 E. Ohio St., Chicago.*

Surface Combustion Winter Air Conditioner

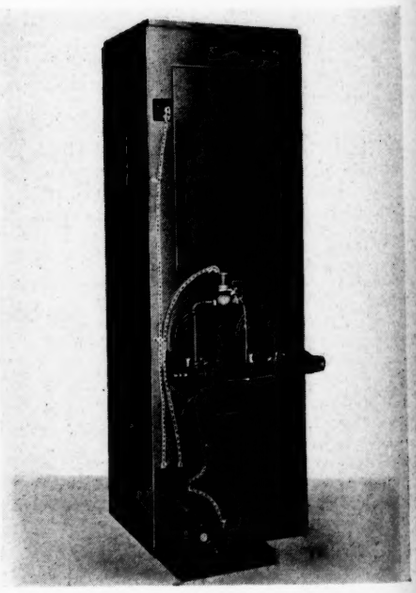
NAME AND MODEL NUMBER—Janitrol gas-fired winter air conditioner, type BC.

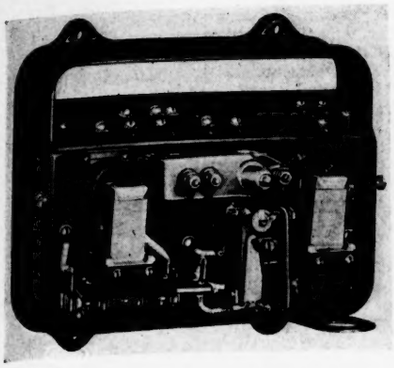
PURPOSE—For heating low cost housing projects and individual apartments.

FEATURES—In view of the fact that many installations of these units will be in service closets or in other locations where space is limited, the depth and width have been kept at a minimum. A squirrel cage blower is used to circulate the air. Various combinations of controls, humidifying equipment and filters are offered with the new unit.

SIZES AND CAPACITIES—Two sizes—45,000 and 90,000 B.t.u. per hr. input.

MADE BY—*Surface Combustion Corporation, Toledo, Ohio.*





M-H Protectorelay

NAME AND MODEL NUMBER — Protectorelay, type R157A.

PURPOSE—A control system for industrial oil burners to give a timed sequence of burner operation.

FEATURES — This relay permits predetermined ignition timing, delayed opening of the oil valve, if required, and a timed scavenger or recycling period. Time switch is utilized for both ignition and oil valve as well as providing a timed delayed return to the cold position. The Protectorelay is also used with the type C56 Pyrostat to provide safe operation of the burner. This safety control overlaps on the heating cycle but not on the cooling cycle. The ignition switch timing is adjustable from 45 to 120 seconds; the delayed oil valve timing is 25 to 35 seconds, and safety switch timing from 80 to 100 seconds.

RATING — 10 amperes at 110 volts and 5 amperes at 220 volts.

MADE BY — *Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.*

Norge Room Coolers

NAME—Portable room cooler.

PURPOSE—A portable unit for supplying cooled, dehumidified and clean air.

FEATURES—Room temperature air is continually drawn into the unit by electric fans, passed through filters and cooling coils and then delivered into the room. Refrigerant is circulated by a Rollator compressor through the cooling coils and is then boiled by the room air which passes over the outside of the coil. The compressed refrigerant is cooled by evaporation of water that is pumped and sprayed over the outside of the condensing coil. The rate of evaporation depends on the amount of moisture in the outside air. Cooling water is supplied by a 10 gal. tank which can be filled manually once each day or automatically through a ¼ in. copper flexible tube connected to a convenient water outlet. 200 c.f.m. of air is circulated by a double width centrifugal fan. Throw-away type filters are used for cleaning. A small slide damper is provided to permit a portion of the room air to be passed through the condensing system and passed outdoors. Cabinet construction is of heavy gage steel. Controls are located under a small flush lift door on top of the cabinet. Freon is used as a refrigerant.

SIZES AND CAPACITIES—45 in. wide x 40 in. high x 24 in. deep; ½ horsepower a.c. motor. Units also available for d.c.

MADE BY—*Norge Division Borg-Warner Corporation, Detroit, Mich.*

Walworth Bronze Valve

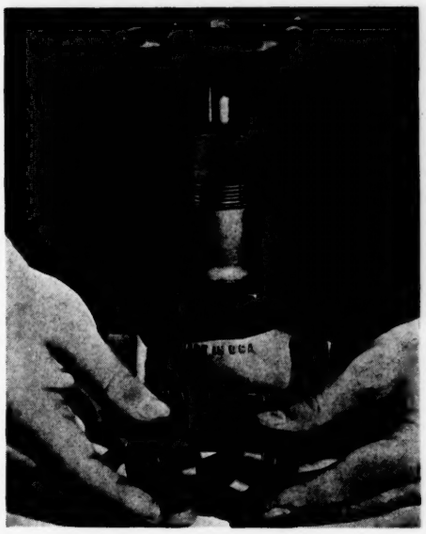
NAME—Walworth bronze valve.

PURPOSE—For general service on steam, air, oil, water, or gas lines where conditions are exceptionally severe.

FEATURES—This valve employs a seat ring and disk of special stainless steel with a minimum hardness of 500 Brinell. It is said that the non-corrosive disk and seat are hard enough to scratch glass. In actual service it is claimed that closing these valves on boiler scale or similar foreign particles will not damage them in any way. The handwheel is constructed of malleable iron and is of the air-cooled, non-heating type.

TYPES AND SIZES—Both globe and angle types and sizes from ¼ to 2 in. Valve ratings are at 350 lb. W.S.P. and at 550F.

MADE BY—*Walworth Co., New York.*



Rega Spray Humidifier

NAME—Rega spray humidifier.

PURPOSE—For adding moisture to air.

FEATURES—Humidifier consists of a 12-in. bowl mounted on a 48-in. stand. In the bottom of the bowl is a self-cleaning spray nozzle which is connected to the city water line. The tubing in the bottom of the bowl is connected to an accessible drain. When the water is turned on a fine fog spray is forced from the spray nozzle into the bowl and then into the room. The manufacturer states that the spray which rises above the bowl is absorbed by the air and that which condenses on the inside of the bowl is carried away to the drain. The spray nozzle operates entirely on city water pressure without the use of a pump.

MADE BY—*Rega Manufacturing Co., 79 Mount Hope Ave., Rochester, N. Y.*

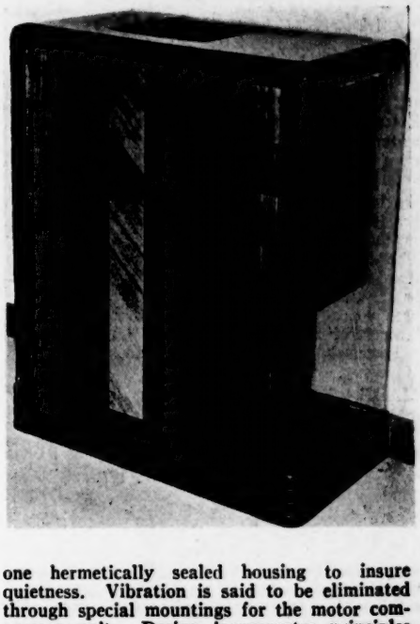
Airtemp Room Cooler

NAME—Airtemp room cooler.

PURPOSE—For cooling, ventilating, dehumidifying and circulating.

FEATURES — Unit incorporates Airtemp's newly developed radial type compressor. The compressor and electric motor are enclosed in one hermetically sealed housing to insure quietness. Vibration is said to be eliminated through special mountings for the motor compressor unit. Design incorporates principles of "floating power". Unit is available in both air cooled and water cooled models and is housed in a walnut cabinet.

MADE BY—*Airtemp, Inc., Dayton, Ohio.*



Babcock & Wilcox Firebrick

NAME—Insulating firebrick.

PURPOSE—For fireboxes in house-heating furnaces and boilers.

FEATURES—The texture of the face of the brick and the brick's porous structure make it, according to the manufacturer, an effective sound-deadening material approximately equal to acoustic plastic in its ability to absorb sound and reduce reverberation in the furnace. The manufacturer also claims a fuel saving and a reduction of the soot hazard through the use of this brick in the combustion chamber of oil-fired furnaces and boilers.

MADE BY—*The Babcock & Wilcox Co., 85 Liberty St., New York.*

Hancock Valve

NAME—Hancock Flocontrol valve.

PURPOSE—A combination flow instrument and shutoff valve.

FEATURES—New line of valves retains the basic proportional flow or straight-line flow characteristics of the original valve. The valve seats and disks are made of superhard stainless steel with a hardness of 500 Brinell. The new Flocontrol valves have an entire new body of the Union Bonnet type.

MADE BY—*Hancock Valve Division of Manning, Maxwell & Moore, Inc., Bridgeport, Conn.*

New Equipment

M-H Surface Tank Regulator

NAME AND MODEL NUMBER—National surface regulator, type M508.

PURPOSE—For controlling operation of tank heaters to assure a constant supply of hot water at any desired temperature.

FEATURES—Regulator may be mounted on a vertical or horizontal line of pipe or on the tank itself. Three special type diaphragms are included in the regulator to provide greater sensitivity, more movement, and more power. The body of the control is so constructed that it provides good contact with the pipe or tank to which it is attached, which in turn provides quick action of the regulator. Regulator is offered complete with one 3-lb. weight, a lever, damper chain, hooks and straps for mounting.

MADE BY—*Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.*

Butterworth Shock Pad

NAME—Butterworth shock pad.

PURPOSE—For use under light machinery to prevent the transmission of vibration.

FEATURES—Shock pads are made of granulated cork and are said to have a slow return from compression. It is claimed that this slow return interrupts any frequency that might be transmitted. Made in convenient sizes for use under oil burners, fans, blowers, pumps, and other light machinery.

SIZES—1, 3, 3¾, 12 and 14 in. diameter and two thicknesses, ¼ and ½ in.

MADE BY—*B. T. Butterworth, Jr., New Canaan, Conn.*

Fulton Register Shield and Humidifier

NAME — Fulton register shield and humidifier.

PURPOSE—For supplying moisture and trapping dust.

FEATURES—Unit is designed to be attached to any register with a screwdriver. The manufacturer states that the humidifier will trap dust rising with the heat and will also supply moist air to the room. Two models are available, one for use on wall registers and one for floor registers.

MADE BY—*Patent Novelty Co., Fulton, Ill.*

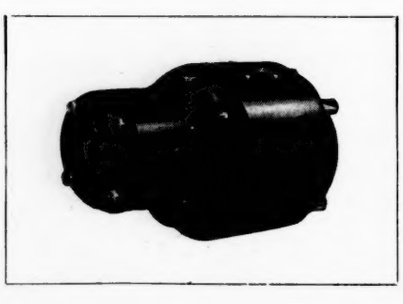
Teesdale Burner Pump Unit

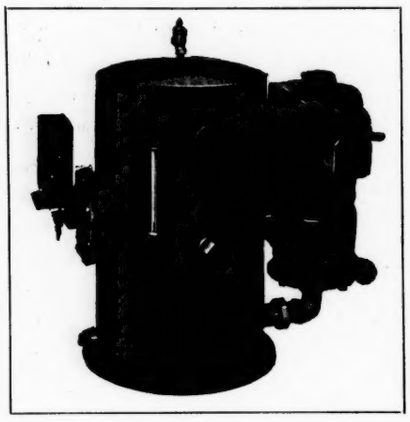
NAME AND MODEL NUMBER — Pressure burner pump unit, type N.

PURPOSE—A combined motor, pump, valves, strainer and motor pump coupling for use with oil burners.

FEATURES—In this unit are combined a motor, pump, valves, strainer and motor pump coupling, so arranged that it can be serviced without breaking the oil line. It is available for any kind of mounting, either with flanged end, foot mounting or as shown. Oil pump and other working parts are submerged in oil.

MADE BY—*Teesdale Mfg. Co., Grand Rapids, Mich.*





Goulds Condensate Pump

NAME—Condensate return outfits.

PURPOSE—For automatically returning condensate from steam radiators and other steam using equipment to low and high pressure boilers.

FEATURES—Condensate is collected in a receiver from which the pump forces it back to the boiler. The manufacturer states that care has been exercised to utilize properly sized receivers so that the water level is not seriously affected. All pumps are either reciprocating or centrifugal, depending on the rating of the equipment. Units are complete with motor with full overload and low voltage protection. All receiver tanks are of rust-resisting, copper-bearing steel. A two-pole float switch with a copper float automatically starts and stops the pump according to the water level in the receiver. Provision for automatic feed water makeup with boiler level control can also be furnished with these outfits. When equipped with this device the outfit will automatically furnish fresh makeup water as well as return to the boiler such condensate as may be available.

SIZES AND CAPACITIES — For handling systems up to 40,000 sq. ft. of radiator surface and boiler pressures up to 120 lb.

MADE BY — *Goulds Pumps, Inc., Seneca Falls, N. Y.*

Electro Humidifier

NAME—Electro Humidaire.

PURPOSE—For adding moisture to room air.

FEATURES—The humidifier hangs in the basement from a ceiling rafter. Flexible piping reaches up through the floor with an opening directly under a radiator. Water from the domestic hot water supply is piped into the humidifier and heated to 185F. The heat of the water draws air into the humidifier which absorbs moisture from the surface of the water and carries it up through the tube. A float valve controls the water level in the humidifier. When used with steam heating systems steam is piped into an indirect steam heater controlled by a hand set valve. With hot water or warm air heating systems an electric heating element is used. Also available in a portable type with a 3-gal. capacity.

MADE BY—*Electro Heating Mfg. Co., Duluth, Minn.*

Alnor Pyrometer Controller

NAME—Alnor pyrometer controller.

PURPOSE—For automatically controlling temperatures of heating devices.

FEATURES—The principle of operation is electronic, similar to a radio circuit. The pointer of the indicating pyrometer carries a small vane. An adjustable target is provided which carries two condenser plates or vanes. These vanes are the capacitive element of a tuned circuit. Except at the point when the temperature indicating pointer and the target coincides the circuit is unchanged. When the temperature pointer with its vane approaches the temperature setting, the vanes of the pointer and target interleave and produce a circuit change which in turn operates a relay. The heating current if electric is shut off or in case of the fuel-fired operation, the fuel valve is closed partially or completely depending upon the type of valve used.

TEMPERATURE RANGES—0 to 300, 0 to 400, 0 to 500, 0 to 600, 0 to 800, 0 to 1000, 0 to 1200, 0 to 1600, 0 to 2000, 0 to 2500, 0 to 3000F.

MADE BY—*Illinois Testing Laboratories, Inc., 420 N. La Salle St., Chicago.*

Herman Nelson Furnaces

NAME AND MODEL NUMBER—Gas-burning air conditioning furnaces N-500, N-1000, and N-2000.

PURPOSE—For winter air conditioning.

FEATURES—It is said that logarithmic spacing of heat-catching fins both inside and outside the flue passages assures uniform temperatures over the entire bonnet area. An induced draft fan provides a positive discharge of spent flue gases. Units are equipped with air circulating fans, filters and a spray type humidifier. Summer cooling and dehumidification may be included at the time of installation or later. Furnace is finished in a baked enamel with a stainless steel trim.

SIZES AND CAPACITIES—Three sizes from 100,000 to 150,000 B.t.u. output at the register.

MADE BY — *The Herman Nelson Corp., Moline, Ill.*

Henry Relief Valves

NAME AND MODEL NUMBERS — Automatic pressure relief valves, types 526, 527, 528, and 529.

PURPOSE — For relieving Freon, methyl chloride, and sulphur dioxide refrigerating systems.

FEATURES—Valves are made of forged brass and are said to provide an instantaneous relief of excess pressure. Angle construction and push rod for emergency reseating permit servicing without removing valve from line or pumping down system. A complete range of pressure settings to be used in relieving either high side or low side to the atmosphere or from high side to low side is available.

MADE BY—*Henry Valve Co., Chicago.*

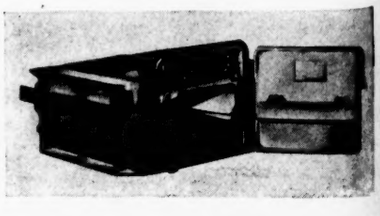
American Radiator Ashpan

NAME—Removable ashpan.

PURPOSE—A removable ashpan for use with the American Radiator No. 7 coal-burning boiler.

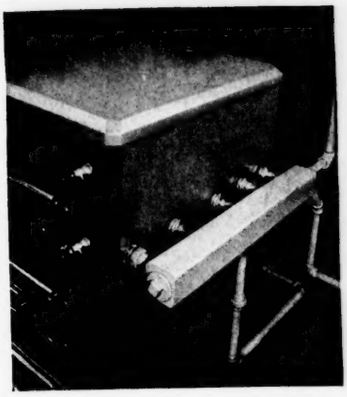
FEATURES—This ashpan weighs 7½ lb. and can hold the equivalent of the ash from two fuel charges, representing in the case of an average or five section boiler 37 lb. of ash. Is made of 18-gage sheet steel, painted black; is 4¾ in. deep with the length and width varying according to the size of the boiler. Baffle plates provided with it are installed in the ashpit to serve as deflectors to direct the ashes to the pan. A small handle is provided on the front of the pit to make it easy to remove and a carrying handle is provided across the top.

MADE BY—*American Radiator Co., New York.*



Hank

Tells How To Carry Water on Both Shoulders



To change from oil to coal, or coal to oil, a change in base is all that's necessary. It's equipped with a flexible-header-connected Burnham Taco Heater.

(And Still Keep Dry)

Sez I to the Boss, we get it in the neck enough without trying to carry water on both shoulders. Besides we ain't no politicians.

To which he replied—well maybe as how we ain't politicians, but this Conversion Boiler of ours, sure got itself elected over all comers. And it got it, by being honest two-faced. One day it can be just the best known boiler for coal; and then the very next, be top-hole for oil.

All it has to do, to go merrily on a-burning whichever fuel is which at the time, is to change its base, just like any smart politician does.

It's just as good and just as honest a friend to coal as it is to oil. And now, since oil has gone up, there's a lot of folks don't take kindly to being tied down to it too allfired tight, by having a boiler that won't burn anything else but oil.

Course we make a special Built-In Oil Boiler and there ain't none better for burning oil. But the Anthracite Association and the Stoker Companies have been reminding folks of the good qualities of coal that some had forgot, and there's a lot of leaning towards coal. Still they keep on sorter leaning towards oil too. For such, this Conversion Burnham is an answer to the maiden's prayer. It burns both, and does one just as good as the other, and even better.

Hank Hindler

BURNHAM BOILER CORPORATION

Manufacturers of Heating Equipment Since 1873

Irvington, New York Zanesville, Ohio

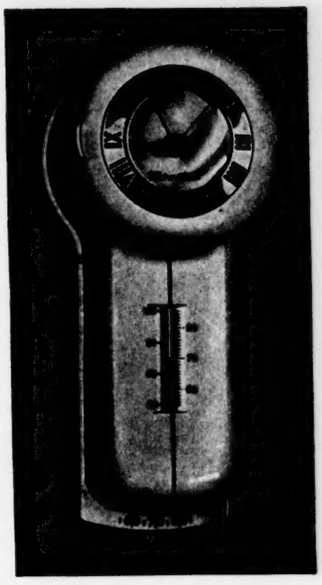
Export Department,

116 Broad Street, New York

Burnham Boiler

Technotrol

The rich attractiveness of this accurate and efficient electric clock thermostat will give its owner a real thrill in pride of possession. Furnished in Ivory or black molded cases, Technotrol combines distinctive beauty with a fine instrument of precision.



Responsive to minute changes in temperature. Technotrol is available in either the Type C-22 two-position model or the famous type C-144 gradual control model. Also furnished with snap action contacts for 2 or 3 wire low voltage control systems.

TYPE B-22

A sturdily built, trouble-free heat regulator that is noted among architects and builders for accuracy and dependability. . . . Twenty years of constant effort have resulted in its outstanding efficiency. Master Heat Regulators respond to a temperature change of 1 degree.

The perfect unit for any home. Low first cost, and it will outlast the heating plant. Write for further information.

Made by the makers of the famous Type B-144, the original gradual control heat regulator.

WHITE MANUFACTURING COMPANY

2364 University Avenue St. Paul, Minn.

MASTER HEAT REGULATOR

Summer Degree-Hours — An Estimating Unit for Summer Air Conditioning

Continuing a monthly service in HEATING & VENTILATING covering summer dry-bulb temperatures in 31 cities

THERE is a fair amount of evidence that that part of the cooling load in air conditioning which depends on the outdoor dry bulb temperature is proportional to the number of hours the temperature is above 85F. The calculation of the number of these degree-hours in the summer depends on the availability of hourly dry bulb temperature readings and for that reason data can not be prepared for all cities. However, the table below gives the number of degree-hours for August and cumulative total to August 31 for 31 cities.

The degree-hour unit is similar to the degree-day unit used for winter estimating, differing however in one important respect—the number of degree-days in a given month in a given city usually compares within ± 20% of the number for the same month in other years; this is not the case with degree-hours which fluctuate all the way from zero to over 800 in the same month in different years. Consequently, the unit does not lend itself to predicting as does the degree-day unit. However, it does enable one to make comparisons of a part of the sensible heat load, with the temperature variable eliminated.

Summer Degree-Hours (Above 85F), August, 1937

August, 1937	August, 1936	City	Year, 1937, to August 31	Year, 1936, to August 31
445	688	Baltimore	1396	1912
696	883	Birmingham	2732	3591
863	618	Bismarck	1575	4504
258	138	Boston	631	345
11	4	Buffalo	27	111
175	320	Chicago	530	1043
331	988	Cincinnati	911	3548
102	99	Cleveland	159	651
326	796	Columbus	760	2518
891	1654	Des Moines	2113	6317
180	566	Detroit	447	1804
185	681	Fort Wayne	500	2599
360	385	Grand Rapids	878	1845
1220	1211	Houston	3500	3257
354	1494	Indianapolis	778	4128
2032	4623	Kansas City	4476	11429
844	1787	Memphis	1967	4267
186	276	Milwaukee	509	1059
710	511	Minneapolis	1606	2895
623	715	New Orleans	2269	2918
108	126	New York	453	556
310	362	Philadelphia	903	1209
216	285	Pittsburgh	472	1175
39	123	Portland, Oreg.	150	168
287	702	Richmond, Va.	1246	1862
1108	2938	St. Louis	2243	7827
0	9	San Diego	0	9
0	0	San Francisco	1	0
490	962	Savannah	2096	3084
211	625	Toledo	537	1932
427	641	Washington	1146	1817

READY NOW
ENTIRELY *NEW* CATALOG

SEND TODAY for
COMPLETE ENGINEERING DATA
on Industrial Spray Nozzles, Atmospheric Spray Cooling Towers Induced Draft Cooling Towers and Forced Draft Cooling Towers

BINKS MANUFACTURING COMPANY
3114-40 CARROLL AVE. CHICAGO

INDOOR *and* OUTDOOR TEMPERATURE *at a Glance!*

MOTOCO located at a convenient place in your home or office not only indicates both the Indoor and Outdoor temperatures at a glance, but also points out the difference between the two.

Indoor temperature to be healthful must be maintained within definite limits. A sudden rise or fall in outside temperature has a direct influence on home heating and ventilation, which cannot be properly regulated without an exact knowledge of the outside temperature changes. MOTOCO keeps you informed at all hours of the day or night.

MOTOCO has an artistic silver finish dial and bevel crystal. It may be obtained in the following colors: maroon, walnut, black, green and ivory.

•

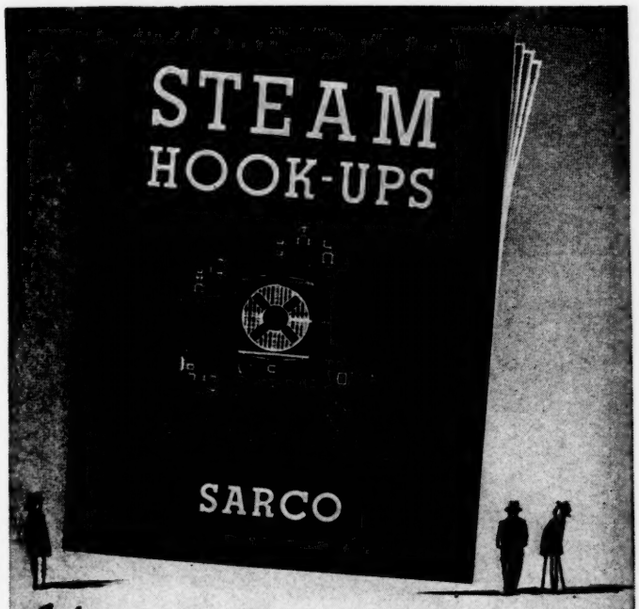
The Motoco line also includes Distance Reading Thermometers, Recording Thermometers, Pressure & Vacuum Gauges and Pressure & Vacuum Recorders for Industrial application.

•

A post card request will bring you complete details of Motoco precision instruments.

MOTOCO
INDOOR AND OUTDOOR
THERMOMETER
PRICE
$12.00

THE ELECTRIC AUTO-LITE COMPANY
MOTO METER GAUGE & EQUIPMENT DIV.
CHRYSLER BUILDING • NEW YORK CITY, N.Y.

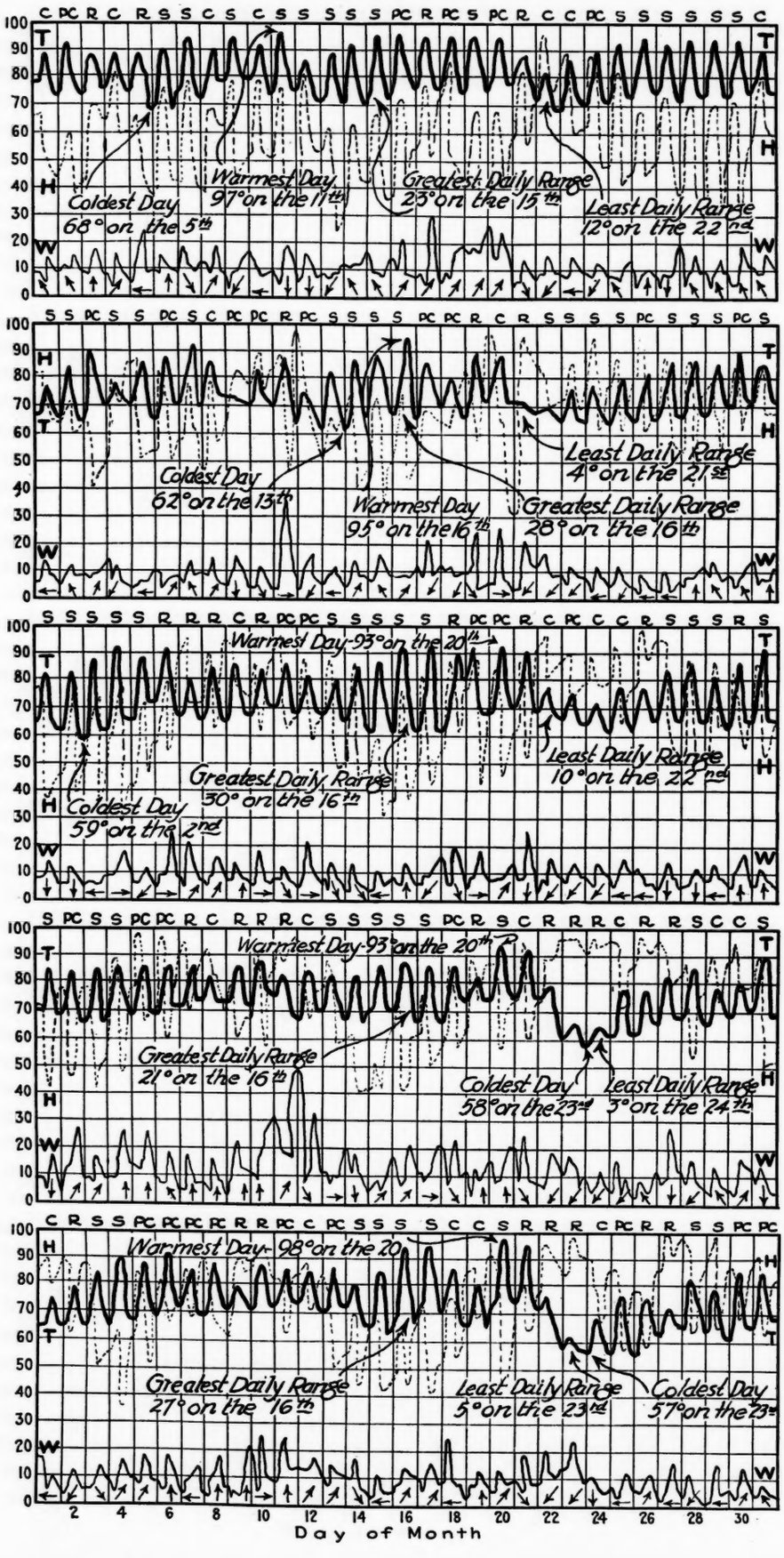


Yes it contains the information you have been looking for:—Hook up drawings, calculation data and illustrations of steam accessories for connecting up heating, air conditioning process equipment, and hot water control. Yours for the asking.

SARCO
COMPANY, Inc. 183 MADISON AVENUE NEW YORK

THE WEATHER FOR AUGUST, 1937

Plotted from records compiled for HEATING & VENTILATING by the U. S. Weather Bureau. Heavy curves (T), dry bulb temperatures in deg. F.; dotted lines (H), per cent relative humidity from readings at 8 a.m., noon, and 8 p.m. Light lines (W), wind velocity in m.p.h. Arrows indicate prevailing wind directions, north being arrow pointing up, etc.; S—clear; PC—partly cloudy; C—cloudy; R—rain; Sn—snow.


Coldest Day 68° on the 5th
Warmest Day 97° on the 11th
Greatest Daily Range 23° on the 15th
Least Daily Range 12° on the 22nd
Coldest Day 62° on the 13th
Warmest Day 95° on the 16th
Greatest Daily Range 28° on the 16th
Least Daily Range 4° on the 21st
Warmest Day-93° on the 20th
Greatest Daily Range 30° on the 16th
Coldest Day 59° on the 2nd
Least Daily Range 10° on the 22nd
Warmest Day-93° on the 20th
Greatest Daily Range 21° on the 16th
Coldest Day 58° on the 23rd
Least Daily Range 3° on the 24th
Warmest Day-98° on the 20
Greatest Daily Range 27° on the 16th
Least Daily Range 5° on the 23rd
Coldest Day 57° on the 23rd
Day of Month

St. Louis

Mean temp. for month, 82.3F; aver. wind velocity, 9.2 m.p.h.; prevailing direction of wind, S.

Chicago

Mean temp. for month, 75.7F; aver. wind velocity, 7.9 m.p.h.; prevailing direction of wind, S.

Pittsburgh

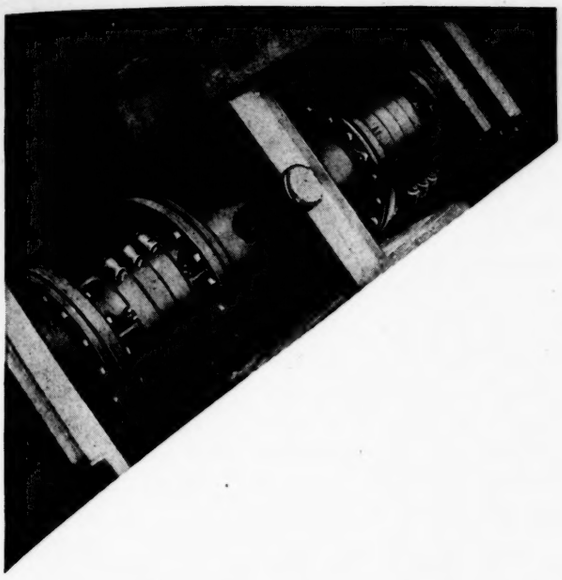
Mean temp. for month, 75.2F; aver. wind velocity, 7.7 m.p.h.; prevailing direction of wind, S.

New York

Mean temp. for month, 75.7F; aver. wind velocity, 10.3 m.p.h.; prevailing direction of wind, SW.

Boston

Mean temp. for month, 74.6F; aver. wind velocity, 8.0 m.p.h.; prevailing direction of wind, SW.



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EXPANSION JOINTS

High pressures—high temperatures . . . normal pressures—normal temperatures . . corrosive conditions or neutral . . . any condition in industrial steam heating can be taken care of with the well-known and well-proved Badger Self-Equalizing Expansion Joints built to the Directed Flexing design.

The user gets a joint selected to best meet the conditions and at the same time a joint that requires no servicing throughout its long life.

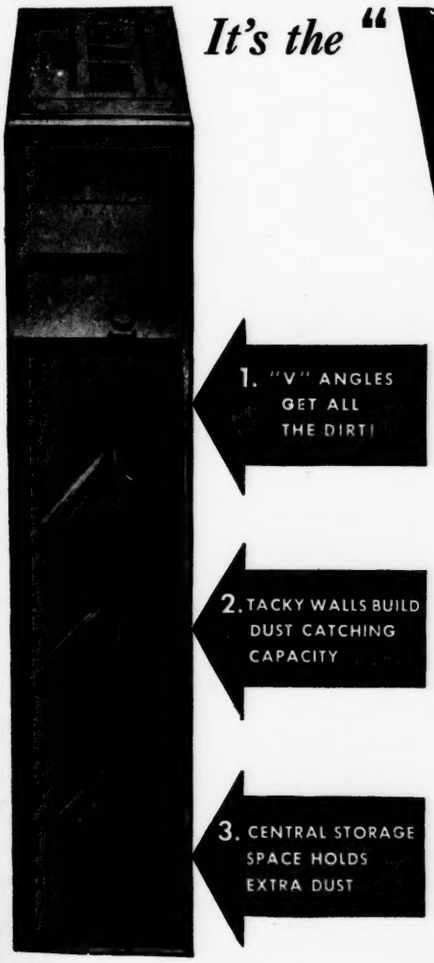
DIRECTED FLEXING

• • • •

STAINLESS STEEL

DEOXIDIZED COPPER

E. B. BADGER & SONS CO.
BOSTON, MASS.



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ARCO AIR FILTERS

. . . *Last Longer*
. . . *Hold More Dirt*

1. The "V" angle construction makes the air change directions quickly and scrub against the sticky sides of the filter. 2. As the dust impinges on the sides of the filter it absorbs the sticky coating and in turn becomes a dust catcher. 3. The space between the two wafers acts as an added storage space for the dust that is collected. Remember there is one of these efficient Arco Air Filters for every air conditioning or ventilating job. They are light, odorless, inexpensive, and won't drip oil even at 180 degrees F. The absolutely uniform construction leaves no weak spots for the dirty air to get through. Write today for complete details.

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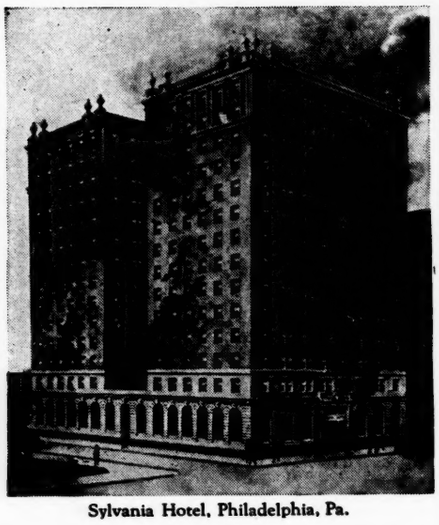
AMERICAN RADIATOR COMPANY
DIVISION OF AMERICAN RADIATOR & STANDARD SANITARY CORPORATION
40 West 40th Street, New York, N. Y.

ARCO AIR FILTERS



Sylvania Hotel, Philadelphia, Pa.

HEATING MODERNIZATION CUTS COAL CONSUMPTION

Sylvania Hotel Saves 260 Tons of Coal in First Year with Webster Hylo System

HEATING COMFORT FOR GUESTS

Philadelphia, Pa.—The Sylvania Hotel reduced coal consumption 260 tons in a single heating season as the result of a Webster Heating Modernization Program carried out in the fall of 1935.

This substantial reduction in heating expense was accomplished in a building only 12 years old by equipping 1,000 radiators with Webster Metering Orifices and applying Webster Hylo Variator Control.

The decision to modernize the heating system in this well-known Philadelphia hotel was based not so much on possible economies as on the opportunity to improve heating service.

The effectiveness of the Webster Hylo System in assuring added comfort for guests is shown in the following statement by Ralph Romspert, Chief Engineer of the Sylvania:

"In two heating seasons, all sections of the Hotel have received steam evenly and rapidly regardless of outdoor weather conditions. Overheating and underheating have been reduced to a minimum."

Before modernization, Webster Engineers estimated that modern heating would save 140 tons of coal per season. During 1935-36, when the degree day load was 17.5 per cent greater than normal, coal savings exceeded the estimate by 86 per cent. For the first five months of the 1936-37 season, when the degree day load was 4.5 per cent greater than normal, coal savings exceeded the conservative estimate by 59 per cent.

The Huffman-Wolfe Co., well-known Philadelphia firm, acted as modernization heating contractors.

These before-and-after facts point the way to maximum comfort and economy in heating new buildings as well as in modernization of existing installations. Consult your architect, engineer or heating contractor. Or address

WARREN WEBSTER & CO., Camden, N. J.
Pioneers of the Vacuum System of Steam Heating
Representatives in 60 principal U. S. Cities — Est. 1888

WEBSTER HYLO SYSTEM

WITH THE MANUFACTURERS

George W. Akers Co., Detroit, has appointed *Marshall Bruce* in charge of sales to the heating trade.

Allen-Bradley Co., Milwaukee, has appointed *Delavan Engineering Co.*, 414 12th St., Des Moines, Iowa, as its Iowa representative.

American Gas Products Corp., New York, has appointed *A. I. Wallace*, associated with the company's Chicago office, as vice-president. He will continue to make his headquarters in Chicago.

Anthracite Industries, Inc., New York, has appointed *Charles C. O'Rourke*, former sales manager of the mechanical displays division, Architects Samples Corp., as special representative. Mr. O'Rourke will devote most of his attention to the consumer exhibits sponsored by Anthracite Industries throughout the east and middle west, and to contact work with manufacturers.

Ralph E. Carlisle, Jr., has been appointed to the field staff. He will represent the organization in Boston.

James R. Ray, manager of the Fritch Coal Co., Bethlehem, Pa., and president of the Pennsylvania Retail Coal Merchants Association, and *Edwin L Collins*, president of the Acme Coal Co., Utica, N. Y., and director of the New York State Retail Coal Merchants Association were elected to the advisory committee of Anthracite Industries August 13.

Electric Furnace-Man, Inc., New York, has appointed *Henry Cunningham, Jr.*, sales promotion manager.

The Emerson Electric Mfg. Co., St. Louis, Mo., has moved its Cincinnati office to *457 E. 6th St.* Jack Searls is in charge.

O. C. Keckley Co., Chicago, has named *L. W. Browne* vice-president in charge of sales and distribution of its steam and liquid control equipment. Mr. Browne was formerly president of Fisher Governor Co.

Kelvinator Div., Nash-Kelvinator Corp., Detroit, announces that part of the commercial territory previously directed from the New York office will be assigned to a new division, headquarters of which have not been announced, to be managed by *L. T. M. Ralston*, New York divisional manager since July, 1936, who has been associated with the air conditioning department since March of last year. *J. K. Knighton*, formerly sales manager of the commercial air conditioning department in Detroit, replaces Mr. Ralston in New York and assumes the title of eastern sales manager of the commercial division. *H. M. McGaughey*, formerly assistant sales manager of the commercial air conditioning department in Detroit, has been appointed to sales manager of the department.

Kelvinator recently held three regional sales conferences in Birmingham, Ala., Knoxville, Tenn., and Charlotte, N. C., attended by distributors, dealers, and wholesalemen. Speakers at the meetings were *E. L. Sylvester*, sales manager of the residential air conditioning and automatic heating department, and *V. E. Watkins*.

The Linde Air Products Co., New York, has moved its Boston district office to *441 Stuart St.*

Norge Div., Borg-Warner Corp., Detroit, has named *Paul B. Zimmerman* vice-president in charge of sales. Mr. Zimmerman recently left General Electric, where he held the position of sales manager of that company, to become associated with Norge.

Penn Electric Switch Co., Goshen, Ind., has named *M. Parcaro* manager of its New York office. He was for thirteen years connected with Carrier Engineering Corp. prior to joining Penn. In that connection he was engaged in design and research.

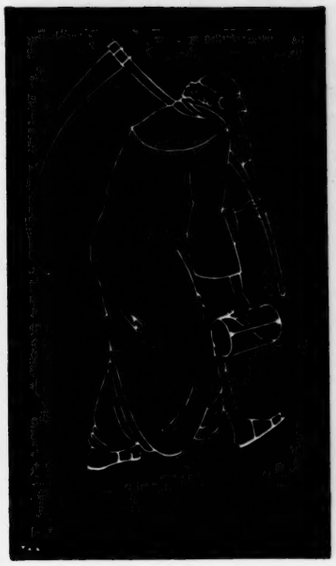
Toridheet Div., Cleveland Steel Products Corp., Cleveland, has appointed *Kelly-How-Thompson Co.*, Duluth, distributor of its oil burners in North and South Dakota, northern Wisconsin, northern peninsula of Michigan, and Minnesota, excluding Minneapolis-St. Paul area. *A. A. Duckett, Inc.*, was named distributor in the Philadelphia-Camden market. Dealers recently appointed are: *Peterboro Lumber Co.*, Peterboro, N. H.; *Desautels Music Co.*, Manchester, N. H.; *David Halperin*, W. Brighton, S. I., N. Y.; *Price and Nichols*, Waynesboro, Pa.; *Burns' Heating Co.*, Niagara Falls, N. Y. *Universal Supply Co.*, Newark, Ohio; *H. W. Dyer and Son*, Battle Creek, Mich.; *J. E. O'Neil and Son*, Clinton, Iowa.

Warren Webster & Co., Camden, N. J., has appointed *C. E. Scott* manager of the radiation and unit heater division of the company's sales department. This division which has handled the Webster system radiation for the past five years has been expanded to handle in addition the Webster-Nesbitt unit heater for which Warren Webster is exclusive national distributor. Mr. Scott, who is chairman of the engineering committee of the Industrial Unit Heater Association, was formerly in charge of the unit heater division of Carrier Corp.

Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa., has named *R. R. Davis*, formerly apparatus advertising manager, assistant to the general advertising manager of the company, S. D. Mahan. Mr. Davis has been associated with Westinghouse advertising activities since 1910.

Wrought Washer Mfg. Co., Milwaukee, Wis., is celebrating its 50th anniversary this year. Formed in 1887 under the name of Nut and Washer Mfg. Co., this company was then equipped to produce about a ton of washers a day, all of standard sizes then in use; today, production can reach 70 tons of washers a day of thousands of sizes and shapes.

Young Radiator Co., Racine Wis., has appointed *F. S. Spear* to an executive position supervising the production of the company's products being supplied to the air conditioning, heating, automotive and tractor industries.



FATHER TIME CUTS NO FIGURE

TIME with his scythe cuts no figure on a Ric-wiL Underground Conduit System. Especially, he doesn't cut the efficiency figure—that good old 90%+! Steam lines encased in Ric-wiL are just about **proof** against the onslaughts of Time—they go right on defying deterioration from moisture, corrosion, inside or outside pressure. That's **permanent** protection!

Water repellence, heat retention, underdrainage, alignment, ease of assembly—all these vital requirements are completely met. Various designs in Tile or Cast Iron to meet all conditions—famous Dry-paC Waterproof Asbestos Insulation. Submit your underground steam problems to Ric-wiL. Ask for complete catalog with Dry-paC sample for testing.

The RIC-WIL Co., Union Trust Bldg., Cleveland, Ohio
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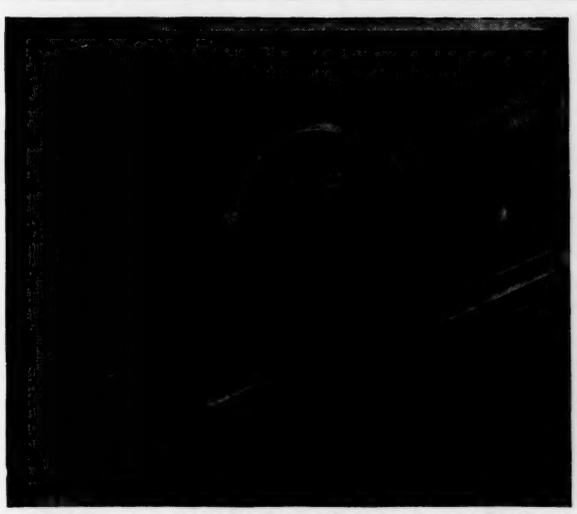
Standard Ric-wiL Conduit is assembled on the job—all materials and workmanship are absolutely *open* to inspection.



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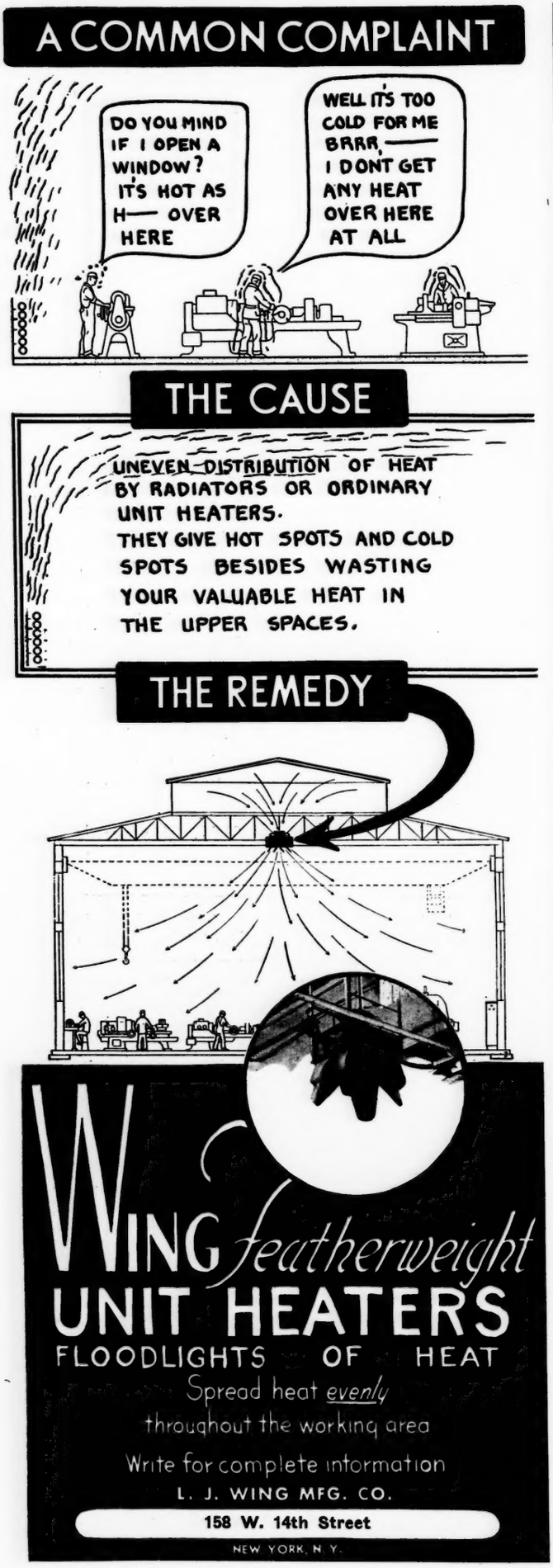
CONDUIT SYSTEMS FOR UNDERGROUND STEAM PIPES


A COMMON COMPLAINT
DO YOU MIND IF I OPEN A WINDOW? IT'S HOT AS H— OVER HERE
WELL IT'S TOO COLD FOR ME BRRR,— I DONT GET ANY HEAT OVER HERE AT ALL
THE CAUSE
UNEVEN DISTRIBUTION OF HEAT BY RADIATORS OR ORDINARY UNIT HEATERS.
THEY GIVE HOT SPOTS AND COLD SPOTS BESIDES WASTING YOUR VALUABLE HEAT IN THE UPPER SPACES.
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WING featherweight
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throughout the working area
Write for complete information
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NEW CATALOGS

(Unless otherwise indicated the publishers of catalogs will supply copies on request without charge.)

American District Steam Co., North Tonawanda, N. Y., has published a 6-page illustrated bulletin, No. 35-76 on Adsco water heaters for industrial and institutional installations, including the type E heater for gravity recirculation, submerged heater and condensate cooling service, and the type F heater for maintaining suitable water temperatures to prevent the freezing of water in elevated steel or wooden tanks.

A. M. Byers Co., Pittsburgh, Pa. A standard-size, 32-page booklet on wrought iron for tank construction. Discusses the characteristics and the advantages of wrought iron for tank construction and describes a number of installations of wrought iron tanks. Gives information on the design and installation of materials for tank construction. More than half the booklet is occupied by photographs of installations of wrought iron tanks.

The Commercial Shearing & Stamping Co., Youngstown, Ohio, has published a standard-size, 28-page catalog on tank heads for hot water tanks, oil burners, and oil storage tanks. Also tank accessories, boiler heads, and stampings.

Dravo Corp., Machinery Division, Pittsburgh, Pa. A 20-page, standard-size catalog on the Lee direct-fired unit heater. Describes the construction features and advantages of this type of unit heater which is available for either oil, gas, or coal firing. Gives installation information and shows a number of typical applications.

Ingersoll-Rand, 11 Broadway, New York, have published a standard-size, 24-page bulletin on water-vapor refrigeration for air conditioning and industrial uses. Bulletin describes the construction and outstanding features of I-R steam-jet cooler of the surface condenser type and of the barometric condenser type. Gives data on the operating characteristics, steam and water requirements, dimensions and capacities. Also, includes a number of typical air conditioning and industrial applications.

Johns-Manville, 22 East 40 St., New York. A 6 x 9 in., 48-page book entitled "Heat." This is divided into five chapters and covers the history of heat from ancient times; the discovery of what heat is with a full explanation of its nature, the science of heat conservation, the modern materials available for conserving heat and illustrations of the specific use of these materials in individual industries. Books are given to persons attending the showing of the Johns-Manville sound picture "Heat and Its Control" or may be had on request, from the above address.

National Machine Works, 1559 Sheffield Ave., Chicago. A standard-size, loose-leaf bulletin on the Lo-Blast gas conversion burner. Describes the features, specifications, sizes and capacities, and gives instructions on the installation of this type of conversion burner. Also gives information on control systems.

Spencer Thermostat Co., Attleboro, Mass. A 48-page catalog of the full line of Klixon thermostatic controls including the electric and gas actuated con-

trols for heating appliances, limit controls, stoker timers, thermostatic electric switches and cut-outs, thermal relays, self-closing temperature and relief valves for hot water supply systems.

H. A. THRUSH & Co., Peru, Ind. A 4-page standard-size bulletin on the Thrush water circulators. Gives features, data on sizes and capacities, and shows a number of typical installation sketches.

WEBSTER TALLMADGE & Co., INC., East Orange, N. J. A 4-page, standard-size bulletin on the Tallmadge Equatherm and Airotherm types of the zoned controlled heating system. Describes the advantages of zone heating and the features of the various types of valves, controls, and orifices used in these systems.

YARNALL-WARING Co., Chestnut Hill, Philadelphia, Pa. A standard-size, 16-page bulletin, WG-1805, covering the Yarway line of water columns and water gages for boilers. Gives complete details of the Yarway floatless Hi-Lo alarm water column and the Yarway line of water level gages for pressures up to 1500 lb.

COMING EVENTS

OCTOBER 4-9, 1937. Chicago Exposition of Power and Mechanical Engineering, International Amphitheater, Chicago. Charles F. Roth, Grand Central Palace, New York.

OCTOBER 5-8, 1937. 66th Annual Meeting, American Public Health Association, Hotel Pennsylvania, New York.

OCTOBER 18-22, 1937. 18th Annual Meeting, American Welding Society, Hotel Traymore, Atlantic City, N. J.

OCTOBER 18-22, 1937. National Metal Exposition (including Welding) Convention Hall, Atlantic City, N. J. W. H. Eisenman, American Society for Metals, 7016 Euclid Ave., Cleveland, Ohio.

NOVEMBER 3-5, 1937. 4th Annual Convention and Exhibit, Refrigeration Service Engineers' Society, Stevens Hotel, Chicago. Herman Goldberg, Chairman, General Convention Committee, 9 S. Clinton St., Chicago.

NOVEMBER 9-12, 1937. 18th Annual Meeting, American Petroleum Institute, Stevens Hotel, Chicago.

NOVEMBER 10-12, 1937. 38th Annual Convention, International Acetylene Association, Birmingham, Ala. Secretary, 30 East 42nd St., New York.

DECEMBER 6-10, 1937. Annual Meeting, American Society of Mechanical Engineers, New York.

DECEMBER 6-11, 1937. 16th Exposition of Chemical Industries, Grand Central Palace, New York.

DECEMBER 27-28, 1937. Drying and Air Conditioning, Subject of 4th Annual Chemical Engineering Symposium of the American Chemical Society, University of Pennsylvania, Philadelphia.

JANUARY 24-26, 1938. Winter Convention, National Warm Air Heating & Air Conditioning Association, Hotel Roosevelt, New York.

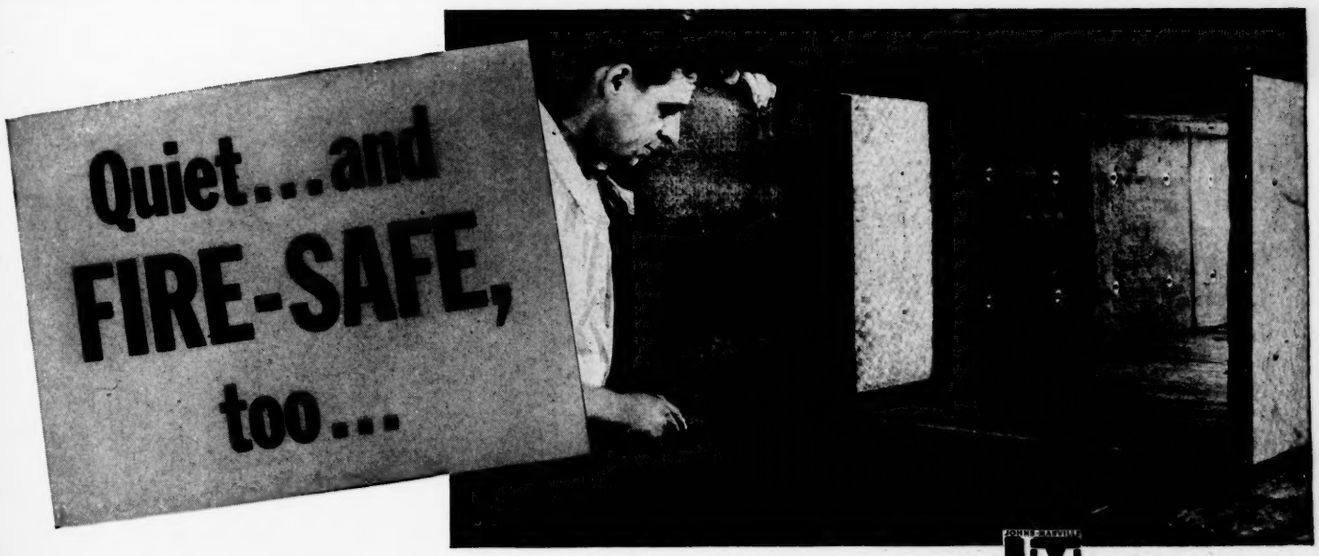
JANUARY 24-28, 1938. 5th International Heating and Ventilating Exposition, Grand Central Palace, New York. Charles F. Roth, Grand Central Palace, New York.

JANUARY 24-28, 1938. 44th Annual Meeting, American Society of Heating and Ventilating Engineers, New York.

JANUARY 26-28, 1938. 33rd Annual Meeting, American Society of Refrigerating Engineers, Hotel Roosevelt, N. Y.

APRIL 11-16, 1938. Mechanical Equipment Show, Textile Hall, Greenville, S. Car. William G. Sirrine, President, Textile Hall Corp., Greenville, S. C.

DECEMBER 5-10, 1938. 13th National Exposition of Power and Mechanical Engineering, Grand Central Palace, New York.



NO SMALL MATTER, the additional factor of fire-safety . . . when lining air-conditioning ducts for sound absorption! Bulletins from the National Board of Fire Underwriters report cases where expensive damage was caused by the absence of this protection.

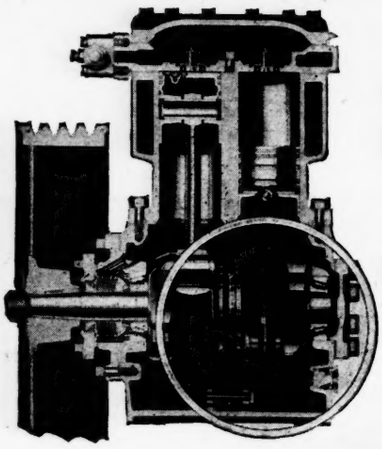
To make sure *your* air-conditioning ducts will never contribute to fire spread, line them with Johns-Manville Airacoustic Sheets. This material has a rate of sound absorption as high as 80% . . . and provides a high degree of fire-safety as well.

Moreover, J-M Airacoustic Sheets provide many other advantages. Permanence, by virtue of their mineral composition . . . resistance to moisture . . . low thermal conductivity . . . light weight . . . and a smooth surface that means low frictional resistance.

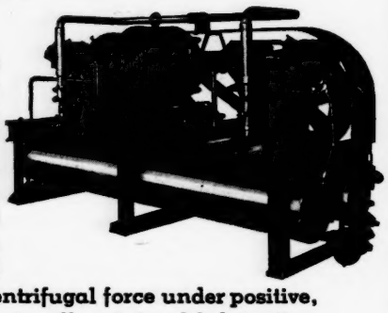
For complete details on J-M Airacoustic Sheets, write Johns-Manville, 22 E. 40th St., New York, N. Y.

JOHNS-MANVILLE
AIRACOUSTIC
SHEETS
For Duct Lining

CURTIS
Condensing Units



"CENTRO-RING" LUBRICATION—
—only
CURTIS COMPRESSORS
have it



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The Curtis line contains 41 air-cooled units, from 1/6 HP to 5 HP, inc., and 45 water-cooled units from 1/3 HP to 30 HP — a size and type to balance most any installation you might make. Curtis has built condensing units for 15 years and has made engineering equipment for 82 years — a record of success that in itself is sufficient warranty of the high-quality of Curtis units of today.

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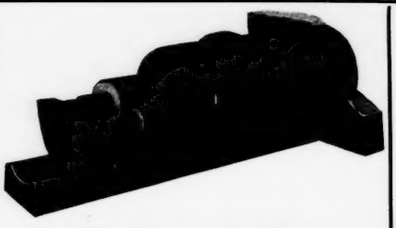
ADSCO-BANNON CONDUIT
TILE CONDUIT FOR UNDERGROUND LINES



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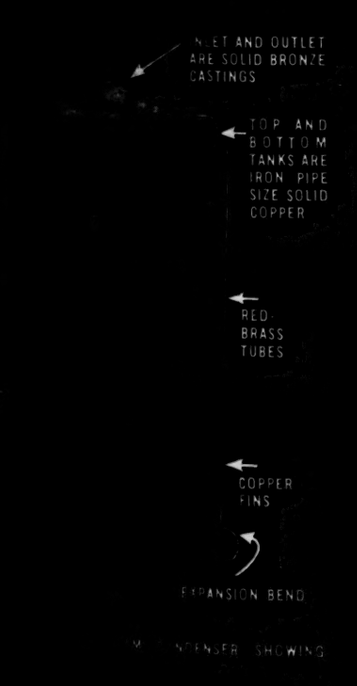
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